MAINTENANCE TRADE COST GUIDEBOOK

NAVAIR 4.2
COST ANALYSIS DEPARTMENT
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PREFACE

This guide has been prepared by the Naval Air Systems Command (NAVAIR) Cost Department to assist in the preparation and evaluation of cost analyses of alternative maintenance concepts to reduce naval aviation operating and support (O&S) costs.

Today's budget constraints are forcing Department of Defense (DoD) components to reexamine the way they conduct business. O&S costs represent a significant portion of naval aviation's Total Obligation Authority (TOA) and have been targeted for reduction in funding for modernization and re-capitalization efforts. Numerous studies have been prepared on alternative maintenance concepts that reduce O&S costs and many more innovative proposals are under review. The objective of this guide is to assist in identification of the appropriate cost elements to consider, the best sources of critical data, and potential cost estimating methodologies.

The guidebook will be updated and improved as new information and tools are made available. The document is controlled by NAVAIR-4.2.5. Please provide any comments, questions or requests for this guide to NAVAIR-4.2.5 (POC: Tim Conley 301-342-0251).

Current Changes:

This version of the guidebook dated December 01, 2004 supplants the previous version dated August 01, 2002. Incorporated into this version is guidance for conducting Performance Based Logistics (PBL)[1] business case analyses (BCAs). The main objective of PBL is to reduce O & S and logistics costs by shifting maintenance responsibilities, where appropriate, from the government to the private sector. The recommended data sources and guidelines for PBL cost analyses included in this version were developed through a cooperative effort between NAVAIR, NAVICP Philadelphia, and the (Defense Logistics Agency (DLA). Appendix I is a proposed cost element structure for use with PBL BCAs. The central point of contact at Naval Inventory Control Point (NAVICP) for PBL issues is NAVICP Code 0361 (Commercial: 215 697 5740.)

[1] Direct Vendor Delivery (DVD) was renamed Performance Based Logistics (PBL) by NAVICP in 29 February 2000

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1.0 INTRODUCTION

1.1 PURPOSE

This document provides guidelines for developing, documenting, and presenting maintenance trade study cost analyses. The guide discusses the requirements for maintenance trade cost estimates, provides instructions for developing such estimates, and presents standard cost element structures. Documentation and presentation requirements are also provided.

The primary objective of the Guidebook is to achieve comprehensive, consistent, and well-documented cost estimates that can be replicated and verified by an independent party.

Listings of pertinent acronyms, points of contact, manpower rates, data sources, and other related information is included throughout this document.

1.2 SCOPE

The enclosed guidelines are intended for use in any maintenance trade cost analysis. Examples of applications include determining the cost impact of:

- Procedural Changes
  - Number of maintenance levels (organizational to intermediate to depot vs. organizational to depot)
  - Source of maintenance (intra-service, inter-service, or commercial)
  - Depth of repair
  - Turn-Around-Time (TAT)

- Design Changes
  - Reliability or maintainability engineering change
  - Built in test capability change

2.0 SCREENING PROCESS

Prior to review of a proposed maintenance alternative concept in detail, the following considerations should be made:

1. Is there enough service life and overall system population to warrant the change?

   - The number of systems affected and the operational period over which the concept can be implemented must be considered as factors in recouping any non-recurring costs associated with making a maintenance concept change. The fewer unit operational years remaining, the less non-recurring costs can be accommodated. Likewise, a longer time period for designing and implementing the maintenance trade proposal will translate into a shorter duration to recoup the initial investment. Hence, the fewer unit operational years remaining, the greater the savings that are required to offset initial implementation costs.

2. Are there systemic parts obsolescence problems?

   - Systems with a majority of components in a technical life cycle decline or phase out may be considered as good candidates for Original Equipment Manufacturer (OEM) maintenance. If the answer to this question is yes, skip question 3 and consider OEM repair.
   - For further guidance, reference Naval Air System Command Cost Department's automated Obsolescence Cost Model and report, Avionics Obsolescence Cost Estimating and Analysis.

3. Is there a high false removal rate (A799) associated with the equipment?

   - A high A799 rate may prevent the use of 2-level maintenance because of the increase in shipping and spares costs and the accumulation of unnecessary charges at the depot level for supporting a system (Any system inducted into a depot, commercial or organic, will be assessed a charge regardless if the repairs are conducted on the system.).

Even if the system under consideration for alternative maintenance does not pass the above three criteria's, the analyst should consider the following:

1. What is the system's reliability?

   - If the current system is operating at a relatively high Mean Flight Hours Between (MFHB) Removal rate, implementation of a 2-level maintenance concept may reduce life cycle costs.

2. What is the system's intermediate-level Beyond Capability of Maintenance (BCM) rate?

   - If the system's intermediate-level BCM rate is relatively high, maintaining the system under a 2-level structure may reduce the overall support cost.

This guidebook will define cost elements to consider for various alternative concepts, identify some critical considerations and data sources, and outline some basic methodology for estimating the life cycle cost impact.

3.0 GENERAL APPROACH

3.1 GROUND RULES

The following ground rules should be adhered to for all cost trade studies performed for alternative maintenance candidates:

- Constant Year Dollars should be used and based upon the Fiscal Year in which the study is done. Inflation indices are required to normalize historical cost data and budget year projections. The latest version of the Office of the Secretary of Defense (OSD) inflation indices should be used and can be found, by appropriation, at the Naval Air Systems Command Cost Analysis home page. If you are accessing the database at PAX from a NMCI computer the address is https://air42cost/. If you are accessing it from a non-NMCI computer or you are at China Lake or Lakehurst the address is https://air42cost.navair.navy.mil/.

- The applicable appropriation to apply to each cost element is identified in Appendix B of this document. Additional guidance on inflation indices use is available from NAVAIR-4.2.5.

- System deliveries and implementation assumptions are to be consistent with the specific system's latest approved Weapon System Planning Document (WSPD) where available.
  - For spares calculations: WSPD peacetime planning factor operating hours per period and combat utilization rates are to be used.
  - System authorized operating service life should be based on the WSPD. For systems with remaining service life greater than 15 years, a 15 years 'life cycle' snapshot shall be provided to assess the cost impact of the maintenance alternative on the system's Life Cycle Cost (LCC) for that period.
  - In cases where an approved WSPD is not available, utilization rates and operating service life assumptions should be cleared with the program's Assistant Program Manager for Logistics (APML).

Pipeline and attrition percentages are to be based upon "CURRENT AIRCRAFT INVENTORY PLANNING FACTORS" CNO ltr Ser 780G10A/3U634063 dated 23 June 2003 and provided in Appendix F. This is an annually updated document that contains factors derived from the past five years of actual data (three years for utilization rates). For maintenance induction purposes, annual flight hours should also be based upon this document.

- Sunk costs, or costs already incurred prior to the maintenance alternative decision point, are not to be included in the analyses.

- For return on investment purposes associated with an individual study, labor cost savings are to be based upon the elimination of a full billet and not solely on workload reduction (partial man-year) only. However, quantification of workload reduction expressed as maintenance man-hours saved shall be identified separately. This will provide the capability for an aircraft level analysis to sum to full billets the reduced workload from individual maintenance decisions related to a work center.

- Government provided military personnel labor rates are to be utilized to estimate military manpower costs. The Navy and Marine Corps Standard Composite Rates are provided in Appendix D. Guidance on government civilian labor rates is available from NAVAIR-4.2.5. Contractors are to utilize fully burdened labor rates in their analyses.

- Tailored cost structures require NAVAIR-4.2.5 approval.

- The maintenance trade estimates shall consist of well-documented cost analyses that can be replicated and verified by an independent party. All estimates shall include an acquisition, acquisition ILS, and O&S summary sheet in addition to a breakdown of the cost elements for each year of the estimate. Significant variations in any year shall be described, along with reasons for the change.

- If the trade study has unique considerations that are not addressed in this document, request approval from NAVAIR-4.2.5 for deviation from the established ground rules established.

3.2 ESTIMATING APPROACH FOR MAINTENANCE DRIVEN COSTS

In order to evaluate the potential cost savings or cost changes associated with a maintenance trade study, it is important that a foundation be constructed based on the current costs of a fielded system. Even if an Engineering Change Proposal (ECP) is proposed, the current system is still the maintenance trade study baseline.

1. Develop a maintenance trade cost study baseline.
    a. Identify an analogous fielded system with recent maintenance history.
    b. Identify the level (system, WRA, SRA or lower) that the data needs to be collected, based upon the maintenance trade being proposed.
    c. To calculate Acquisition ILS costs, use SERMIS, FEDLOG, AUTOSERD, or HAYSTACK as possible sources for data.
    d. For Operating & Support cost, use VAMOSC ATMSR or NALDA data systems to construct at least a three year history of expended maintenance costs that address "O" and "I" level labor costs, maintenance consumable materials, and component repairs (Aviation Depot Level Repairables) at the level determined above.
    e. Convert Navy organic reported labor costs into man-hours. (Note: Labor dollars reported by VAMOSC can be converted to hours by referencing the cost per hour used in VAMOSC and then applying the higher burdened cost per hour.)
    f. Inflate all historical costs to a constant year dollar base using the current approved inflation guidance referenced in Appendix B.
    g. Convert these costs into an average cost per flying or usage hour that becomes the trade study baseline.

2. Identify those conditions impacting maintenance that change based upon the recommended maintenance trade study approach.
    a. Identify complexity/cost differences from the new system (if an ECP is proposed) that would drive costs.
    b. Identify any R&M changes that would result from the recommended approach.
    c. Identify maintenance level changes that result in changes to how maintenance is done, source of maintenance and/or level of maintenance.
    d. Identify any other changes that will impact the historical cost baseline.

3. Using the information provided in steps 1 and 2 above, develop a clearly documented and auditable approach illustrating the deviation from current system cost (labor, equipment, and

process) to those proposed. Quantify these deviations/savings in each category, including decreases in labor content expressed as dollars.

4.0 COST STRUCTURE

When studying an alternative maintenance concept's life cycle cost, the greatest amount of effort should be expended on the cost elements that account for the largest portions of cost and are affected by the success of the proposed maintenance alternative. Table 1, which is not purported to be comprehensive, identifies the significant cost driver elements for the various maintenance concepts described in the following paragraphs.

- The Engineering Change Proposal (ECP) column indicates cost elements to consider in an analysis where an actual change in hardware is proposed to reduce Operating and Support (O&S) costs by improving system reliability or maintainability. This change may require redesign cost, production of new hardware, and installation/integration of the change. Due to the change in hardware inherent in this cost reduction approach, the number of cost elements that may be impacted and therefore must be considered is higher than if only the level or source of maintenance is being considered.

- A Contractor Logistics Support (CLS) alternative occurs when the contractor assumes the responsibility for the repair program.

- A Two-Level Contractor (2LC) maintenance philosophy is demonstrated when the government maintains the organizational ("O") level system support and contracted out to industry depot repair function. Performance Based Logistics (PBL) is an example of the (2LC) maintenance concept. Organic personnel remove suspect items for the 2LC and vendors perform repairs at their facilities. PBL includes the removal of a failed WRA or SRA at the "O" level, which is shipped to a vendor (original equipment manufacturer or other) for repair.

- A Two-Level Organic (2LO) maintenance philosophy entails government support of a system at the "O" level and at a government (intra-service, inter-service) depot.

- A Three-Level Contractor (3LC) maintenance concept occurs when the Navy supports equipment replacement repair at the "O" & "I" levels. The 3LC contracts depot support for repairs beyond the capability of repair of the "I" level. "O" level maintenance actions could consist of: 1) repairs through WRA replacement; 2) "I" level WRA repair through SRA replacement; and 3) SRA repair of those items with "I" level capability. Contracted depot repair in the form of PBL could then consist of SRA repair of those items beyond "I" level capability.

- Three-Level Organic (3LO) maintenance is similar to three-level contractor maintenance but with a government depot repairing items beyond "I" level capability in place of a contractor.

Table 1: Maintenance Trade Cost Element Structure

	ECP	CLS	2LC/ DVD	2LO	3LC/ DVD	3LO
ACQUISITION COST:						
Design	✓					
Production	✓					
Installation	✓					
ACQUISITION ILS COST :						
LSA/Maintenance Planning	✓	✸	✸	✸	✸	✸
Supply Support (Spares)	✓	✓	✓	✓	✸	✸
Support Equipment	✓	✸	✸	✸	✓	✓
Technical Data	✓	✸	✸	✓	✸	✓
Training	✓	✸	✸	✸	✓	✓
Facilities (Avionics) Facilities (Engines, Air Frames)	✸ ✓	✸ ✓	✸ ✓	✸ ✓	✸ ✓	✸ ✓
Packaging, Handling, Storage & Transport	✓	✓	✓	✓	✸	✸
OPERATING & SUPPORT COST:						
"O" Level Maintenance Personnel	✸	✸	✸	✸	✸	✸
AVDLR & Contractor Depot Repair	✓	✓	✓	✓	✓	✓
"I" Level Maintenance Personnel	✓				✓	✓
"I" Level Material	✓				✓	✓
Recurring Facility Costs	✸				✸	✸
Support Equipment Maintenance	✓	✸	✸	✸	✓	✓
Software Maintenance	✸	✸	✸	✸	✸	✸
Recurring Training Cost	✓	✸	✸	✸	✓	✓
Program Support	✸	✸	✸	✸	✸	✸

Where:

ECP = Engineering Change Proposal **✓ = Significant Cost Driver**
CLS = Contractor Logistics Support **✸ = Secondary Cost Driver**
2LC = Two Level Maintenance with Contractor Depot/ Performance Based Logistics
2LO = Two Level Organic Maintenance
3LC = Three Level Maintenance with Contractor Depot/ Performance Based Logistics
3LO = Three Level Organic Maintenance

5.0 COST ELEMENT INFORMATION

5.1 ACQUISITION COSTS

Design

Definition: Nonrecurring investment cost associated with any change. The design cost includes any development efforts associated with a hardware/software change to reduce cost, improve reliability or maintainability.

Trade Considerations:
- Sunk costs should not be considered.

Data Sources:
- Industry proposals
- NAVAIR-4.2
- Historical Aircraft Procurement Cost Archive (HAPCA)

Production

Definition: The cost to manufacture the kit that is installed in the aircraft.

Trade Considerations:
- Sunk costs should not be considered.
- Providing the OEM with configuration control may lead to reduced acquisition costs.
- HAPCA

Data Sources:
- Industry proposals
- NAVAIR-4.2

Installation

Definition: The cost to affix and integrate the kit into the aircraft.

Trade Considerations:
- Installation costs may not be considered at the time of system failure or forced retrofit if the installation work package is not significantly different.

Data Sources:
- Industry proposals
- NAVAIR-4.2
- Naval Aviation Depots (NADEPs)
- HAPCA

5.2 ACQUISITION ILS COSTS Logistic Support Analysis (LSA)/Maintenance Planning

Definition: Cost for the government and contractor to explore alternatives and to develop the maintenance concepts and requirements for the life of the system. The final output of this process is the system maintenance plan.

Trade Considerations:

- The level of repair/replacement and complexity of the system will be the main cost drivers for this element. For new systems, such as the replacement for the ARC-210 radio, maintenance plans are required. A maintenance plan for a new component will not be required if the new component is a repairable item that consists of non-repairable components or is a consumable item. A system maintenance plan is usually not updated for one or two item changes. Instead, a new item is added to the Navy Inventory Control System through a manual update. If the repair level is changed, a SM&R (Source, Maintenance and Recoverability) code change request form is processed.

Data Sources:
- Existing Maintenance Plans can be obtained from the Assistant Program Manager for Logistics (APML) or the logistics manager at the Cognizant Field Activity (CFA). The present repair level for an item can be obtained through the NAVICP database.
- Cost Estimating for Logistics Support Analysis (CELSA)
- Navy Inventory Control Point (NAVICP)

Supply Support (Spares)

Definition: There are two types of spares to consider when forecasting sparing levels, retail and wholesale. Retail refers to initial spares secured at the site(s) to support operational aircraft and intermediate level repair actions at that site. Wholesale spares are additional spares required to fill the standard depot repair pipeline. Retail spares are considered site driven, while wholesale spares are event driven. Wholesale spares fill the expected demand for an item during its depot repair turn around time (TAT). These spares are typically stored at Navy supply centers and released to the user when a unit has been turned into the depot for repair. Wholesale spares replace the retail spares at the site.

Trade Considerations:
- The retail and wholesale spares calculations presented herein are influenced by the following three input variables: I-Level and D-Level Turn-Around-Times (TATs), I-Level Beyond Capability of Maintenance (IBCM) rates, and Mean Flight Hours Between Failure (MFHBF) (or Mean Time Between Failure (MTBF), if MFHBF is unknown). A decrease in TATs or IBCM rates will result in fewer retail and wholesale spare quantities. In the case of reduced TATs, the analyst must address the potential for any additional costs associated with the means employed to reduce transportation times.
- Reliability improvement initiatives may result in an increase in MFHBF (or MTBF) leading to a decrease in retail and wholesale spare quantities. When including reliability improvement in a spares estimate, the analyst needs to address any nonrecurring design and development costs in addition to hardware (H/W) and software (S/W) installation costs associated with the change.
- A change in Level of Repair could affect the demand for spares.
- Care should be taken when using predicted MFHBF for calculating spares or repair induction requirements. In some cases, these predictions only include “design controllable” failures or are overly optimistic to support a specified reliability. Consider reliability predictions using a comparable system verses actual ratio.

Data Sources:
- The Weapon System Planning Document (WSPD) provides the best programmatic source for aircraft specific data required for estimating spares. The WSPD projects the peacetime and combat flying hours, and number of operating aircraft located at each site (aircraft carrier (CV), Marine assault ship (LH) and land base). The WSPD also identifies total overall aircraft, total active aircraft, and total operating aircraft in the inventory for each calendar year. <u>Only the quantity of operating aircraft is considered when determining spares demand</u>.

- NALDA 3M data provides an excellent data source for: IBCM rates, failure rates, turn around times, and other reliability & maintainability information.

Support Equipment

Definition: SE refers to all equipment required to support the operation and maintenance of a system. This includes associated multiple use end items, ground handling and maintenance equipment, tools, metrology and calibration equipment, test equipment and automatic test equipment.

There are three major categories of support equipment, Common SE (CSE), Peculiar SE (PSE) and "yellow gear" (although yellow gear is common). CSE consists of previously fielded equipment that can be used to test multiple avionics systems, airframes, or engines. Yellow gear includes mechanical hardware painted yellow for safety reasons; fork lifts, jacks, fire equipment are examples. PSE is new equipment required to support a specific program. For example, a Consolidated Automated Support System (CASS) test station is considered CSE since it has the capability to test multiple avionics systems. However, the Operational Test Program Set (OTPS) required to interface an avionics system to the CASS station is categorized as PSE. Each avionics system (e.g., AN/ALR-67, AN/ALE-50, etc.) has its own peculiar OTPS that is required to test that system on CASS. TPS software, however, is described in the software sections of this guidebook.

Trade Considerations:

- Contractors' proposals should address the level of repair and need for new or modified PSE.
- PSE is normally the only element of support equipment that needs to be addressed in a maintenance trade study. CSE, tools, calibration and maintenance equipment, etc. are common to the government's inventory and not typically bought to support individual systems. However, if there is no CSE available to support the system at a particular site, the cost of CSE acquisition, installation, and maintenance should be included in the analysis. The PSE element is a cost driver in maintenance trade decisions between repair at an organic depot or original equipment manufacturer (OEM) facility. If the necessary PSE has already been procured (sunk cost), this element should not be a cost driver for fielded systems.
- Many new systems have additional Built In Test capability, which decreases the quantity and cost of the PSE required to support that system.
- Training for support equipment is not addressed since this cost is captured with the system's training.
- The ILS element of facilities for SE is also included with the system's cost.

Data Sources:

- The Support Equipment Resources Management Information System (SERMIS) provides a source for identifying PSE National Item Identification Numbers (NIINs) and acquisition data from its database of approved SERD data. SERMIS cost data should not be used, since the procurement year is not specified. Cost data should be derived from other sources (see below).
- Automated Support Equipment Requirement Document (AUTOSERD), like SERMIS, provides a repository of approved SERD data, but also includes work-in-progress SERD-related information. AUTOSERD and its user-interface are probably more user-friendly than SERMIS. AUTOSERD is maintained at NAWCAD-Lakehurst. (Both PSE and CSE data are in AUTOSERD.)
- PSE development can be derived from the contact with the OEM, which should be available from the program office. AUTOSERD does have a data field for SE development (nonrecurring) costs but it is often not reported, and reflects an estimate, not the contractual amount actually spent.
- The NAVICP Master Index File (MIF) (formerly, Master Data File or MDF), FEDLOG, and HAYSTACK databases are reputable sources for PSE procurement history (quantities, dates, prices). The NAVICP MIF database contains data on all 1R (consumables) and 6R (repairables) cog items. "Application codes" do not explicitly show which costs are for SE and which are for support of SE; the distinction is derivable. AVDLR costs (which included CSE and PSE costs) can be found in both

MIF and VAMOSC data, but VAMOSC is the preferred source since it is WUC driven rather than NIIN. VAMOSC also reflects AVDLR costs from a repair and replenish perspective, rather than just a supply perspective. The Repair-Of-Repairables data would be useful for showing depot level repair costs for large mechanical SE. Commercial firms (depots) via retainer contracts often support this equipment.

- The I-Level Beyond Capability of Maintenance Rate (IBCM Rate) should be identified in the maintenance trade proposal, and is derivable from 3-M data and VAMOSC NAMSR/NAMSR PLUS.
- PSE annual operating hours can be approximated as follows: *shipboard sites*, two 12-hour shifts or 24 hours, per day, multiplied by 6 month deployment plus one month roughly of dock-side up-time = 5110 operating hours per year; *Naval Air Station sites*, 16 hours per day five days per week = 4160 operating hours per year; *organic* depot, same as NASs, 4160 operating hours per year; commercial *depot*, 40 hours per week year round = 2080 operating hours per year.
- The projected site stand-up schedule is obtained from the Weapon System Planning Document (WSPD). Another source for SE site requirements is the Logistics Requirements Funding Summary (LRFS) document written by the APML.
- NALDA includes labor hours and labor rates, but not for maintenance of SE. (NALDA Help Line: 800-624-6621.)

Technical Data

Definition: Technical Data and Publications cover scientific or technical information recorded in any form. Technical data consists of written instructions such as drawings, operating and maintenance manuals, specifications, inspection, test and calibration procedures, manufacturing process data, and documentation of computer programs/software.

Technical manuals consist of hard copy operator and maintenance manuals, Integrated Electronic Technical Manuals (IETMs), and Portable Maintenance Aids (PMAs). Typical manuals are the Operator's Manual, Maintenance Manual, and the Illustrated Parts Breakdown (IPB).

Trade Considerations:

- The majority of the costs under this element are incurred prior to the aircraft/system fielding. Subsequent changes to the maintenance philosophy will usually have minor cost impact on technical data.
- If the maintenance technical manuals normally prepared for Fleet use have not been generated (i.e., the system is still in development), the cost associated with preparation can be avoided by implementing a 2-level contractor maintenance concept.
- If an ECP is part of the maintenance trade, the cost of new or changed pages to existing publications may be significant. The cost for each page updated varies widely depending on the contractor involved and the complexity of the change. Please see Appendix H.
- Drawings will continue to be maintained irrespective of a change in maintenance philosophy.
- If the acquisition of a new system is involved, major costs for technical data will be required. The costs for technical documentation will vary considerably based on the system complexity, the maintenance concept, and the contractor involved.
- Do not assume that the cost of changing pages in an ETM is lower than the cost associated with a changed page in a traditional paper technical manual. Conversely, a change in a Class IV ETM (IETM) may require significantly more resources to implement.

Data Sources:

- Proposals should include the number and type of pages to be changed or added.
- Naval Air Technical Services Facility (NATSF)
- NAVAIR-4.2.5 ETM Cost Benefit Analysis

Software Modifications

Definition: Please refer to Software Maintenance.

Computer Resources

Definition: Any other computer related (facilities; software; hardware; ADP personnel) costs that are not accounted for in other ILS elements.

Trade Considerations:
- Avoid double counting computer resources that are embedded in other ILS elements.

Data Sources:
- Computer Resource Life Cycle Cost Management Program (CRLCCMP)
- Cost Analysis Requirements Document (CARD)

Training

Definition: Training, trainers, and trainer support refer to the processes, procedures, techniques, and equipment used to train personnel to maintain the system.

Trade Considerations:
- In some cases, training hardware is procured for the dual purpose of training operators and support personnel. As such, the requirement for training hardware will remain to support the operators, independent of the decision to implement/remove I-Level support capability.
- Airframe and engine maintenance trade analyses will need to consider the cost for unique maintenance trainers.

Data Sources:
- Proposal should address additional training and trainer requirements
- PMA-205 Aviation Training Systems Program Office
- Naval Aviation Maintenance Training Group (NAMTRAGRU) Headquarters Code 3215
- Navy Training Plan (NTP)

Facilities

Definition: Real property assets supporting a system. This requirement includes conducting studies that define facilities or facility improvements, locations, space needs, utilities, environmental requirements, real estate requirements, and equipment.

Trade Considerations:
- This cost element is not considered for most avionics systems since the work center will not create the need to stand-up a new bench within the facility for the addition/subtraction of a system. However, for larger avionics systems, such as radar systems, there is a need to apportion space within a repair facility to accommodate the system's workload.
- Airframe and engine maintenance trade analyses will need to consider the cost for establishing dedicated facility(s).

Data Sources:
- The principal data source for facility costs will be industry proposals.
- NAVFAC P-80, Facility Planning Criteria for Navy and Marine Corps Shore Installations Handbook dated October 1982 managed by the NAVFAC Criteria Division in Norfolk, VA. The latest issue of this document includes changed pages, though the date of the document remains October 1982.
- DoD Facilities Cost Factor Handbook Version 4 (May 2002).
- Naval Air Systems Command (NAVAIR)

Packaging, Handling, Storage, and Transportation (PHS&T Containers)

Definition: The resources, processes, procedures, design considerations, and methods to ensure that all system, equipment, and support items are preserved, packaged, handled, and transported properly. PHS&T responsibility is to consider environmental conditions and transportation for all items, including the preservation requirements for short/long term storage. PHS&T cost reflect the initial shipment of items and the containment cost incurred to safely transport them.

Trade Considerations:
- Assume one container for each spare.
- For maintenance trade exercises, the cost of new containers for all additional spares represent all or most of PHS&T costs.

Data Sources:
- The program office logistics manager for PHS&T should be able to provide cost information regarding this subject.
- NAVICP functions as a source of cost information for generic and peculiar shipping containers.
- NAVICP Master Database

5.3 O&S COSTS

"O" Level Maintenance Personnel
Definition: The pay and allowances for the full-time military and civilian personnel who perform maintenance on and provide ordnance support to assigned aircraft, support equipment, and unit-level training devices. Depending on the maintenance concept and organizational structure, this element will include maintenance personnel at the organizational level and may also include the intermediate level.

Trade Considerations:
- Reduction in "O" level personnel will not be a major driver in most maintenance trade studies. Unless it is determined that an "O" level billet can be eliminated, quantification of workload savings should be left in hours and not addressed as a cost savings.
- The organizational level is often unaffected by alternative maintenance structures. Simply, it usually is an analytical "wash."

Data Sources:
- VAMOSC Naval Aviation Maintenance Subsystem Reporting (NAMSR) provides a break out of "O" level hours associated with repair of individual systems and subsystems.
- Navy Activity Manpower Documents or Marine Tables of Organization describe standard manning by billet.

“I” Level Maintenance Personnel

Definition: The cost of military and civilian human resources supporting aircraft at the intermediate level, including Marine Corps personnel under Fleet Commander major claimancy. Labor activities include calibration, repair, testing, and replacement of parts, components, or assemblies, and technical assistance.

Trade Considerations:

- Cost savings in I-level personnel should not be identified without government approval of proposed billet reductions.
- Reductions in man-hours or partial work-years should not be quantified as cost savings without billet reduction. However, they shall be separately identified to assist in the evaluation of minor changes associated with multiple trade study results.
- In some cases, there may be as many as three degrees of I-Level support established to maintain an engine. These degrees of repair are described as follows:

  - First-Degree Repair: The repair of a damaged or non-operating gas turbine engine, its accessories, or components to an acceptable operating condition. The first-degree repair includes the compressor rotor replacement and/or disassembly where the compressor rotor could be removed. While not performed at depot level, any repair that goes beyond that authorized for a second-degree activity should be defined as a first-degree repair.

  - Second-Degree Repair: The repair of a damaged or non-operating gas turbine engine, its accessories, or components to an acceptable operating condition. Second-degree repairs normally include the repair or replacement of turbine motors and combustion sections, including afterburners. The replacement of externally damaged, deteriorated, or time-limited components, gearboxes or accessories, and minor repairs to the compressor section are also included. Furthermore, the repair or replacement of reduction gearboxes and torque shafts of turbo-shaft engines and compressor fans of turbofan engines (which are considered repairable within the limits of the applicable intermediate maintenance manual) are done by second-degree activities.

  - Third-Degree Repair: This repair encompasses major engine inspections; removal and replacement of engine modules, and the same gas turbine engine repair capability as second-degree repair. However, certain functions that require high maintenance man-hours and have a low incidence rate are excluded.

Data Sources:

- The VAMOSC Naval Aviation Maintenance Subsystem Report (NAMSR) provides a break out of “I” level hours associated with repair of individual systems and subsystems.
- Navy Activity Manpower Documents or Marine Tables of Organization describe standard manning by billet.
- Office of the Under Secretary of Defense (Comptroller) DoD Military Composite Standard Pay and Reimbursement Rates (Appendix D).

“I” Level Material

Definition: The cost of repair parts, assemblies, subassemblies, and material consumed in the maintenance and repair of aircraft, associated support equipment, and unit-level training devices.

Trade Considerations:

- This cost element should only be addressed in maintenance trade studies where the elimination of the I-level activity or major changes in the BCM rates is an option. However, even when the I-Level is eliminated, the material costs at this level are usually not a significant cost driver.

Data Sources:
- The VAMOSC NAMSR database provides the best source for I-Level material costs.
- The VAMOSC database connects Navy maintenance expenditures to the repaired individual avionics system using the system's Work Unit Code (WUC). In some cases, the VAMOSC NAMSR I-Level material costs provide support to the avionics system by including the maintenance of support equipment and unit-level training devices.

D-Level Maintenance Support, Organic AVDLR

Definition: The unit level reimbursement cost for stock fund purchases of Depot Level Repairable (DLR) spares (also referred as exchangeable) used to replace initial stocks. DLRs may include repairable individual parts, assemblies or sub-assemblies that are required on a recurring basis for the repair of major end items of equipment. All depot level repairable item estimates are based on their AVDLR cost set by NAVICP. When the AVDLR charges for an item (by multiply the number of depot inductions for an item) the following six cost elements are covered: D-Level maintenance personnel, D-Level material costs, NAVICP surcharge, attrition spares, recurring transportation, and recurring facility costs.

Trade Considerations:
- Maintenance trades should address AVDLR surcharge categories in addition to the repair cost. The AVDLR costs per unit reported by NAVICP (identified in their database) incorporate these charges. In the case of DVD they need to be separately identified.
- Most repairable items within fielded systems have an assigned AVDLR. If not, the AVDLR for an analogous system may be used with appropriate adjustments for differences in cost and complexity. AVDLR estimates should be given to the APML for concurrence.
- *For PBL analyses the primary source for demand data will be the NAVICP demand database. VAMOSC data should be considered as a corroborating source to assure all NIINs for a particular WUC are captured.*

Data Sources:
- VAMOSC NAMSR for AVDLR
- NAVICP database for AVDLR

Depot Airframe/Engine Rework & Repair

Definition: The cost associated with the scheduled and unscheduled repair of a whole airframe engine or engine module. The cost to repair these items is not covered by the AVDLR process.

Trade Considerations:
- The estimate should include material and labor so that organic or commercial labor rates can be applied.
- Material cost is usually the same whether provided by NAVICP or a contractor.
- Fully burdened labor must be used.

Data Sources:
- Production Performance Reports (PPR)
- NADEP Business Offices
- Contractor rate letters available from DCMC
- DCAA Audit Results (DCAA performs audits on DOD contractor's labor rates; is available through the DCAA Regional Offices)

D-Level Maintenance Support, Commercial

Definition: There are seven categories included in this classification, which are equivalent to the AVDLR Charges plus profit.

1. **Maintenance Personnel**

   Definition: Defined as the cost of civilian human resources supporting aircraft at the depot level. Activities include calibration, repair, testing, and replacement of parts, components or assemblies, and technical assistance.

   Trade Considerations:
   - When appropriate, this data may be in contractor proposals.
   - This is normally a major O&S cost. It is important that maintenance man hours per repair is as accurate as possible and its value can be justified. If the analysis is considering a transition from 3-level to 2-level maintenance, then all of the items removed are sent to the depot without an I-level screening. There is a need to have confidence that appropriate man-hour factors and labor rates are applied.

   Data Sources:
   - AIR 4.2 Guidance
   - Defense Industrial Fund Management System (DIFMS)
   - Contractor proposal

2. **Maintenance Materials**

   Definition: Cost of repair parts, assemblies, subassemblies, and material consumed in the maintenance & repair of an aircraft, associated support equipment, and unit-level training devices.

   Trade Considerations:
   - Can be a significant cost. Rationale for the material cost or repair with supporting data is necessary.

   Data Sources:
   - Defense Industrial Fund Management System (DIFMS)
   - Contractor proposal

3. **NAVICP Cost Recovery Rate**

   Definition: NAVICP imposes a Cost Recovery Rate on every NSN they manage.

   Trade Considerations:
   - Items that meet the PBL criteria will continue to be Cost Recovery Rate; however, it is possible a lower Cost Recovery Rate would be levied based on Cost Recovery Rate elements, identified by NAVICP, which can be subsumed by the contractor.
   - For a Two-Level Contractor (2LC) maintenance approach, some elements of the Cost Recovery Rate may be eliminated upon NAVSUP approval. A formal process has not been established, as sufficient data is not available to make a determination on Cost Recovery Rate value. In the interim, all requests and questions regarding Cost Recovery Rate reduction should be directed to the following NAVSUP points of contact:

     NAVSUP Code 134 717-605-6483

Data Sources:
- NAVSUP Code 134 for Cost Recovery Rate

4. Attrition Spares

Definition: All management actions, procedures, and technology used to acquire, receive, and catalog attrition spares. This includes additional spares required to fill the standard depot repair pipeline. These fill the expected demand for an item during its TAT. Whether or not the piece of equipment has been condemned is also taken into consideration.

Trade Considerations:
- This can be a significant cost. If a condemnation rate is not available for the repairable under study, rationale is required for the method used (e.g. analogy) in the development of the rate.

Data Sources:
- NAVICP
- 3M Data

5. Recurring Transportation

Definition: Reflects the recurring cost to transport systems to/from maintenance facilities to/from operating sites.

Trade Considerations:
- Commercially provided Depot Level Repair cost should be determined as FOB Origin. Recurring Transportation charges to/from the repair activity are covered by the Naval Supply System SMART Transportation System. If the vendor intends to cover any portion of the transportation cost it must be at no additional cost to the government. For more information contact Robert Sax, NAVICP, 215-697-2886, email: robert_sax@icpphil.navy.mil
- If there are any special shipping and handling requirements such as storing and transporting in cryogenic conditions, vacuum packaging, or peculiar containers, these costs must also be estimated.

Data Sources:
- NAVICP can provide standard government shipping costs.
- Commercial shippers such as Federal Express or United Parcel Service

6. Profit

Definition: This is the contractor's fee.

Trade Considerations:
- NADEPs are at a competitive advantage relative to for-profit OEMs.

Data Sources:
- NAVICP or the responsible Defense Contracting Activity
- Contractor proposal

7. Recurring Facility Costs

Definition: The cost of personnel pay and allowances, material, and utilities needed for the maintenance and operation of system specific repair facility.

Trade Considerations:

- Recurring facility costs for organic depot repair is included in the AVDLR charge.
- Most contractors include their recurring facility costs in their proposed repair cost. It is recommended the analyst verify with the contractor that recurring facility costs are included in their proposed cost of repair or fully burdened labor rates.

Data Sources:

- Site/contractor specific
- Defense Industrial Fund Management System (DIFMS)

Support Equipment Maintenance

Definition: The costs incurred to maintain equipment that is needed to operate or support a primary system, subsystems, training systems, and other support equipment. The support equipment being maintained (e.g., tools and test sets) may be unique to the system (PSE) or it may be common to a number of systems (CSE). CSE costs could be allocated among the respective systems, but as per DoD Instruction 5000, the systems using the CSE do not pay for the CSE. Allocating such costs will, in all probability, not affect decisions of placement, distribution, or funding of CSE.

Trade Considerations

- PSE is normally the only element of support equipment that needs to be addressed in a maintenance trade study. CSE, tools, calibration and maintenance equipment, etc. are common to the government's inventory and not typically bought to support individual systems. However, if there is no CSE available to support the system at a particular site(s), the analyst should include CSE acquisition, installation, and maintenance costs in the analysis.
- If the system under study will use the currently existing CSE, maintenance costs do not need to be considered since these costs will be incurred by the Fleet whether the system uses the CSE or not.

Data Sources

- SERMIS provides a source for identifying PSE NIINs.
- The NAVICP MIF (MDF), FEDLOG, and HAYSTACK databases are reputable sources for PSE procurement histories. VAMOSC and MIF databases include AVDLR costs.
- I-Level beyond capability of maintenance rate (IBCM Rates) should be identified in the maintenance trade proposal.
- PSE acquisition data are in AUTOSERD and SERMIS databases, maintained by NAWCAD, Lakehurst.
- PSE annual operating hours can be approximated as follows: *shipboard sites*, 24 hours per day multiplied by 6 month deployment plus one month roughly of dock-side up-time = 5110 operating hours per year; *Naval Air Station sites*, 24 hours per day year round = 8760 operating hours per year; *organic depot*, two 8 hour shifts per day five days per week, year round = 4160 operating hours per year; *commercial depot*, 40 hours per week year round = 2080 operating hours per year.

Software Maintenance (S/W)

Definition: Software Maintenance: the labor, material, and overhead costs incurred by depot-level maintenance activities, government software centers, laboratories, or contractors for supporting the update, maintenance and modification, integration, and configuration management of software. Includes operational, maintenance, and diagnostic software programs for the aircraft, installed equipment, support equipment, and training equipment. The respective costs of operating and maintaining the associated computer and peripheral equipment in the software maintenance activity should also be included.

- TPS (Test Program Set) refers to the software portion of PSE/OTPS
- OTPS (Operational Test Program Set) includes the group of all TPSs that will run on the single associated interface device and refers to the collection of:
    - Interface device and/or hardware (if necessary - for example, an interface with a CASS (Consolidated Automated Support System) station)
    - Cables
    - TPS instruction
    - TPS diagnostic hardware
- ATE (Automated Test Equipment) refers to peculiar hardware. The required supplemental equipment to CSE could be some simple link, but usually refers to more substantial diagnostic hardware.

Trade Considerations:

- The following input parameters need to be considered to determine maintenance costs: software maintenance source (organic or commercial), software language, quantity of Source Lines Of Code (SLOC or LOC) to be modified, engineering estimate of software complexity, and function points data.
- Additional costs may be incurred which are not included in all parametric software cost estimating methods:
    - System integration
    - Independent verification and validation
    - Configuration management

Data Sources:

- Proposals and contracts should address the projected level of effort to maintain the software, in terms of the number/type of lines of code, or percentage of total code, impacted by the change. Also, the software language used should be identified.
- Note: if actual contracts are evaluated to obtain an "acquisition cost" upon which an annual percentage change factor is to be applied, be sure to use the recurring software cost, not the total cost, if the contract shows such a breakdown. Contracts may also be a good source for software development cost as well as the program office.
- Software Support Centers
- Commercial software cost estimating models.
- Computer Resource Life Cycle Cost Management Program (CRLCCMP) and Cost Analysis Requirements Document (CARD) data at NAVAIR Patuxent River or the program office (see methodology section).
- Note: the costs of OTPSs are in SERMIS. Recurring costs of TPS software should therefore be embedded in the cost of the hardware listed in SERMIS, but development (nonrecurring) costs are often not included, and in any case, SERMIS is not the preferred source for cost data since it reflects the cost at one point in time, and that point in time (year) is not identified. TPSs may also have their own SERD number, and be listed in SERMIS separately, but again, SERMIS is not the preferred source for cost data.

Estimating software development and acquisition costs is not substantially different than estimating software maintenance costs. The same techniques or models are used, but a larger range of inputs is required. These include parameters such as initial concept evaluation, requirements engineering, design, development, etc. Major redesigns, new development of large interfacing software, and modifications that change functionality of the software, should be considered development, rather than maintenance. The methods used for both development-type efforts and maintenance are described in the "methodology" section of this guidebook

Recurring Training

Definition: The cost of instructors preparing for (including the materials used) and teaching classes to educate maintenance personnel on how to perform repairs.

Trade Considerations:

- Training preparation and presentation costs should only be included in the maintenance trade proposal if one of the following conditions is met. 1) these functions are performed by a contractor and 2) the government has established a separate billet(s) to perform these tasks which can be eliminated if the training requirement is removed.
- Recurring training for large WRA like engines can be captured by identifying the anticipated NAMTRA or contractor billets since they only provide training for one WRA.

Data Sources:

- PMA-205 Aviation Training Systems Program Office
- Naval Air Maintenance Training Group (NAMTRAGRU) Headquarters Code 3215

Program Support

Definition: This is defined as all TEAM personnel (Fleet Support Team) costs, including engineering and maintenance support, that can be attributed to the system under maintenance trade consideration.

Trade Considerations:

- Program support that can be eliminated as a result of the maintenance trade consideration should be included in the analysis.
- Configuration management, In-Service Engineering, and ILS Management infrastructure may be reduced if the contractor is given the full life cycle support responsibility.

Data Sources:

- APML
- Logistics Requirements Funding Summary (LRFS)

Other Support

Definition: If applicable, this element represents additional Navy or government labor resources supporting the system under construction.

Trade Considerations:

- NADEP or NAWCAD personnel conducting engineering investigations or overseeing support equipment acquisition may be eliminated as a result of the maintenance trade proposal.
- For example, implementation of 2-level OEM maintenance from 3-level organic maintenance may eliminate the need for selected Navy support personnel.

Data Sources:

- APML
- NAWCAD
- NADEPs

APPENDIX A: ACRONYM LIST

ACT	Annual Change Traffic
ADP	Automated Data Processing
ADPE	Automatic Data Processing Equipment
AIMD	Aircraft Intermediate Maintenance Department
AIRRS	Aircraft Inventory Readiness Reporting System
APML	Assistant Program Manager for Logistics
ASO	Aviation Supply Office
ATE	Automated Test Equipment
AUTOSERD	Automated Support Equipment Requirements Document
AVCAL	Aviation Consolidated Allowance List
AVDLR	Aviation Depot Level Repairable
BAS	Basic Allowance for Subsistence
BAQ	Basic Allowance for Quarters
BCAs	Business Case Analyses
BCM	Beyond Capability of Maintenance
BIT	Built in Test
BOA	Basic Ordering Agreement
BOR	Budget Operating Target (funding) Report
CAIG	Cost Analysis Improvement Group
CAO	Competency Aligned Organization
CARD	Cost Analysis Requirements Document
CASS	Consolidated Automated Support System
CCDR	Contract Cost Data Reporting
CELSA	Cost Estimating for Logistics Support Analysis
CER	Cost Estimating Relationship
CETS	Contractor Engineering Technical Services
CFA	Cognizant Field Activity
COCOMO	Constructive Cost Model
COR	Contracting Officer's Representative
CRLCCMP	Computer Resource Life Cycle Cost Management Program
CSE	Common Support Equipment
DCAA	Defense Contract Audit Agency
DCMC	Defense Contract Management Command
DFAS	Defense Finance Accounting Service
DIFMS	Defense Industrial Fund Management System
DLA	Defense Logistics Agency
DLR	Depot Level Repairable
DMS	Digital Map System
DOD	Department of Defense
DRP	Designated Repair Point
DTAT	Repair Turn-Around-Time (TAT) at the Depot
DVD	Direct Vendor Delivery
ECOMTRACK	Engine Component Tracking (NALDA Database)
ECPs	Engineering Change Proposals
FEDLOG	Federal Logistics Database
FMEA	Failure, Modes, and Effects Analysis
FMECA	Failure Modes, Effects, and Criticality Analysis
HAPCA	Historical Aircraft Procurement Cost Archive

IBCM	Beyond Capability of Maintenance at Intermediate Level
IETM	Integrated Electronic Technical Manual
ILS	Integrated Logistics Support
IMA	Intermediate Maintenance Activity
IOC	Initial Operational Capability
IPB	Illustrated Parts Breakdown
ITAT	Repair Turn-Around-Time (TAT) at the I-Level
LCC	Life Cycle Cost
LRFS	Logistics Requirements Funding Summary
LSAR	Logistics Support Analysis Record
LORA	Level of Repair Analysis
MALS	Marine Aviation Logistics Squadron
MC	Major Claimant
MCRC	Master Component Rework Control
MF	Mobile Facility
MFHBF	Mean Flight Hours Between Failure
MIF	Master Index File
MNT	Maintenance
Mods	Modifications
MRC	Maintenance Requirements Card
MRF	Maintenance Replacement Factor
MSA	Maritime Surveillance Aircraft
MTBF	Mean Time Between Failure
NADEP	Naval Aviation Depot
NALDA	Naval Aviation Logistics Data Analysis
AEMS	Aircraft Engine Management
ECA	Engineering Cognizant Activity
FOJ	Fleet Originated Job
IMA	Intermediate Maintenance Activity
TDAIR	Technical Directive Air
NATSF	Naval Air Technical Services Facility
NAVAIR	Naval Air Systems Command
NAVFLIRS	Naval Flight Record Subsystem
NAWCAD	Naval Air Warfare Center, Aircraft Division
NAVICP	Navy Inventory Control Point
MIF	Master Index File
MDF	Master Data File
NCCA	Navy Center for Cost Analysis
NCWF	Navy Capital Working Fund
NETS	Naval Engineering Technical Services
NIIN	National Item Identification Number
NSN	National Stock Number
PCS	Permanent Change of Station
O&I	Organizational and Intermediate Levels of Repair
O&S	Operating & Support
O&MN	Operations & Maintenance, Navy Funding Appropriation
O&MN/LF	Operations & Maintenance, Navy Funding Appropriation (Less Fuel)
OEM	Original Equipment Manufacturer
OPTAR	Operational Target (Funding)
OSD	Office of the Secretary of Defense
OTPS	Operational Test Program Set

PBL	Performance Based Logistics
PEO	Program Executive Office
PHS&T	Packaging, Handling, Storage & Transportation
PMA	Program Manager at NAVAIR; Portable Maintenance Aid
PPR	Production Performance Reports
PSE	Peculiar Support Equipment
PSF	Price Stabilization Factor
R&M	Reliability and Maintainability
RDT&E	Research, Development, Test & Evaluation
REVIC	Revised Intermediate COCOMO
RFI	Ready For Issue
RFP	Request for Proposal
ROI	Return on Investment
ROM	Rough Order of Magnitude
RPF	Rotatable Pool Factor
SE	Support Equipment
SERMIS	Support Equipment Resources Management Information System
SHORCAL	Shore Consolidated Allowance List
SGLI	Servicemen's Group Life Insurance
SLOC	Source Lines of Code
SM&R	Source, Maintenance, and Recoverability Code
SRA	Shop Replaceable Assembly
T/M/S	Type/Model/Series
TEC	Type Equipment Code
TPS	Test Program Set
TOA	Total Obligation Authority
UTD	Unit Training Device
UUT	Unit Under Test
VAMOSC	Visibility and Management of Operating & Support Costs
NAMSR	Naval Aviation Maintenance Subsystem Report
ATMSR	Aviation Type/Model/Series Report
WRA	Weapon Replaceable Assembly
WSPD	Weapon System Planning Document
WUC	Work Unit Code

APPENDIX B: APPLICATION OF INFLATION FACTORS

Cost Element	Inflation Index
Personnel	MPN COMPOSITE
Petroleum, Oil, and Lubricants (POL)	Fuel
O & I Maintenance Consumables	OM&N (PURCHASES)
Aviation Depot Level Repairables (AVDLRs)	OM&N/LF (COMP)
Depot Airframe/Engine Rework	OM&N/LF (COMP)
Training Expendables	WPN
Aircraft Overhaul/Support	OM&N/LF(COMP)
Engine Repair/Rework	OM&N/LF(COMP)
Support Equipment	APN
Support Equipment Maintenance	OM&N/LF(COMP)
Modifications	APN
CETS/NETS	OM&N/LF(COMP)
Software Maintenance	OM&N/LF(COMP)
Simulator Operations	OM&N/LF(COMP)
Indirect Support - Base Operations & Health Care Personnel	MPN(COMP)
Indirect Support - Personnel & Health Care Supplies	OM&N (PURCHASES)

Current Inflation Tables and Guidance contained in the Naval Center for Cost Analysis Web Site:
http://www.ncca.navy.mil

APPENDIX C: COST DATA SOURCES/DESCRIPTIONS

OP-20 Budget Analysis Report

The OP-20 report is issued by OPNAV Code N889E2 and consists of two reports. One is an execution report containing actual expenditure data as reported by various OPTAR budget holders. The second report is a planning document used by the Department of the Navy to brief Congress on budgetary requirements.

The source data for both OP-20 reports is the Budget OPTAR Report (BOR), which is submitted monthly by all OPTAR budget holders (i.e., each squadron, AIMD, Functional Wing, certain others). The term "OPTAR budget holders" includes all Navy and Marine operational squadrons, AIMD's ashore and afloat, functional wings, and certain higher commands. Note that the cost elements in the BOR are categorized by Type Equipment Code (TEC).

There are three basic cost headings reported in the OP-20: FUEL, DLR (Depot Level Repairable), and MNT (Maintenance). The data contained in these headings can be broken down as listed below. The reference for this breakdown is NAVSO P3013, Financial Management of Resources, Appendix II.

- **FUEL**
  Data Source: Organizational Level (Squadron) BOR Report
  Data Contained: OFC-01/7B
  Remarks: Only costs for aviation fuel used in flight operations are reported.

- **DLR**
  Data Source: Intermediate-Level (AIMD, MALS) BOR Report
  Data Contained: OFC-50/9S
  Remarks: The costs charged to the supply department for depot level repair of materials. Sometimes also called Aviation Depot Level Repairable (AVDLR). Note that engine costs are included as part of the aircraft data.
- **MNT**
  Data Source: BOR Reports submitted by Squadrons, IMA /MALS, Functional Wings.
  Data Contained: OFC-01/7F, [Squadron], OFC-50/2F [Wings], OFC-50/7L [IMA/MALS]
  Remarks: Captures operational costs not reported as either Fuel or DLR. The costs reported as "MNT" originates in the BOR from all levels, and includes the following items:

OFC-01/7F OMA Flight Equipment; Other: Reported by the squadrons. Includes cost data for pilot/crew flight clothing; consumable office supplies; aerial film; recording tape; chart paper used in flight; liquid and breathing oxygen; nitrogen; shock lubricants and grease; flight deck and safety shoes; aircraft maintenance costs and repair costs when located other than active Marine or Navy bases; forms and publications (II COG); special clothing; wet suits; and some minor items, such as plaques, etc. Reported separately for each aircraft type equipment code (TEC).

OFC-50/2F Other Flight Operations Support: Flight training support costs including maintenance of drones and targets. More. Catch-all for costs that support aircraft, but not directly. More precisely, "...funds are granted to units to support those costs not specifically identified to be covered by any other OFC." (MAG Fiscal Manual, pg. 2-5.) This includes things such as Automatic Data Processing Equipment (ADPE), both SUADPS and NALCOMIS; mobile facility (MF) support; maintenance service contracts for TBA and ADP equipment; purchasing and maintaining drones, etc.; weather operations; air traffic control operations; prepositioning of equipment such as in Norway; range fees; etc. Generally, the MALS is granted this money by the Marine Aircraft Wing, who spells out specifically how and where the money is to be spent.

OFC-50/7L Aircraft Operations Maintenance: Reported by the AIMD/MALS. Includes consumable repair parts; pre-binned material; fuels and lubricants used in test and check of engines; aprons, face shields and other material in NAVAIR 0035QH series; fuels used in shipboard GSE; replacement of components used in test bench repair and rotable pools; paints, rags, cleaning compounds used for corrosion control; hand tools used in readiness and repair of aircraft and components; maintenance and repair of aircraft loose equipment listed in the aircraft inventory record; repair and maintenance of flight clothing; replacement of consumable special tools and IMRL items; forms and publications used in support of direct maintenance of aviation components and aircraft; repair of IMRL equipment; replacements of GPETE which is missing or unserviceable; oils, lubricants, and fuel additives consumed in flight operations; repairable NSA material having a Material control code of E, H, G, Q, or X (non-AVDLR, to include repairable material used in direct maintenance of aircraft, drones, targets, component repair, or related GSE). Reported separately by aircraft type equipment code (TEC). Note that engine costs are rolled up into the cost data for their respective aircraft, as this is the way it is used in the OP-20 projections.

Automated Support Equipment Recommendation Data (AUTOSERD)
AUTOSERD is an automated management system to process and control SERDs. The purpose of AUTOSERD is to provide: 1) a single consistent source of data entry into SERMIS; 2) an audit trail for SE; and 3) budgetary data for the acquisition of SE. The SERD (approximately 50 data elements) must be approved before it can be entered into SERMIS. Queries can be generated on AUTOSERD. There are data fields for both recurring and nonrecurring costs, but nonrecurring costs may or may not be reported, and are estimates only. Recurring data are for the last procurement only, and the year of that procurement is not shown. AUTOSERD and SERMIS data are useful for obtaining noncost information; cost information can be obtained from procurement-history databases once the appropriate part numbers are identified from AUTOSERD and SERMIS. AUTOSERD is the sole source of SERMIS input data. Whereas AUTOSERD includes SERDS in development, SERMIS includes only approved SERD data. The two databases are independent. Contractor access to AUTOSERD must be requested through the company's Contracting Officer's Representative (COR). Government access to AUTOSERD must be approved through the Command's ADP security office. Assistance gaining access to AUTOSERD information is available from Mr. John Melin NAWCAD Lakehurst, NJ, 732 323 1494

Visibility and Management of Operating and Support Costs (VAMOSC)
The source for VAMOSC data is the Navy Center For Cost Analysis (NCCA), http://www.navyvamosc.com/.

- ***Naval Aircraft Maintenance Subsystem Report (NAMSR)***

VAMOSC NAMSR displays detailed aircraft maintenance cost and non-cost data for all Navy and Marine Corps aircraft Type/Model/Series (T/M/S) at organizational, intermediate, and depot level of maintenance. Most data are relevant only to aircraft repairable components. Summary cost and non-cost data are provided for aircraft and engines. A data element structure of approximately 374 elements in eight sections has been labeled "reports" and can be generated for 2-, 5-, and 7- digit Work Unit Codes (WUC).

- ***Aircraft Type/Model/Series Report (ATMSR)***

  VAMOSC ATMSR displays total operating and support costs for all aircraft T/M/S. The report includes aircraft inventory and consumption data. The data element structure contains 72 data elements comprising the main commodities contributing to operating and support costs. The report has a hierarchical display structure focusing first on aircraft T/M/S, then on major claimant, and finally on the maintenance level (organizational, intermediate, depot). Source: Navy Center for Cost Analysis (NCCA).

Naval Aviation Logistics Data Analysis (NALDA)

The NALDA system is an operational automated information system. Data from the Naval Aviation Maintenance and Material Management Data System (Aviation 3M), the Navy Inventory Control Point – Philadelphia (NAVICP), and the Naval Air Technical Services Facility (NATSF) reside within NALDA. NALDA provides a centralized, comprehensive data bank that can be readily accessed by naval aviation analysts. The system is designed to meet the daily data requirements of ILS and O&S analysts. For further information about NALDA, access their Internet homepage address at http://logistics.navair.navy.mil/.

Weapon System Planning Document (WSPD)

The WSPD is a *classified* basic policy & planning document, published by Naval Air Systems and produced to provide direction and guidance necessary for development, procurement, and logistic support of naval weapons systems. It is designed to present, a single document, the approved Chief of Naval Operations (CNO), Program Executive Officer (PEO), Commander, Naval Air Systems Command, and Commandant of the Marine Corps plan for a given aircraft or weapon system. Cost analysts can obtain WSPD data from the APML.

The following list identifies information found in a typical WSPD:

- Program Points of Contact
- T/M/S General Description
- Procurement/Inventory for T/M/S Aircraft
- Test Program
- Assignments/Base Loading (Homeport/Rotational/Carrier Deployments)
- Support Equipment Requirements
- Configuration
- Special Support Requirements (i.e., MALSP Planning Factors)
- Rework Facilities, Rework Philosophy, and Operating Service Periods
- Training Policy and Equipment
- Mobile Facility Requirements
- Planning Factors/Flying Hours/Maintenance & Spare Parts Support Policy

Manning Documents

The source for SQMD, AMD, and TO is NAVAIR-4.2.5.3, (301) 342-0251.

- ***Squadron Manpower Document (SQMD)***

SQMDs are approved by DCNO (M&P) (N1) and display quantitative and qualitative manpower requirements for an individual aviation squadron or a class of squadrons and the rationale for the determination of the manpower requirements. Requirements are predicated upon statements of Required Operational Capabilities (ROC)/Projected Operational Environment (POE), aircraft configuration, specified operating profile, computed workload and established doctrinal constraints. SQMDs are generated prior to AMDs and represent only manpower requirements. The SQMD is then put into the Total Force Manpower Management System (TFMMS) which produces an AMD.

- ***Activity Manpower Document (AMD)***

  AMDs define the qualitative and quantitative expression of manpower requirements/ authorizations for a naval activity. AMDs reflect both the required and authorized manning levels and are the documents that drive the assignment of specific personnel. Since authorized manning levels will usually be less than the required levels, it is important for the analyst to use the authorized manpower numbers from an AMD to estimate personnel costs in a maintenance trade analysis. The following describes the uses and applications of the AMD:

  a. As an expression of manpower needs of an activity, it is the authority used by the Chief of Naval Personnel (CHNAVPERS) and the applicable Enlisted Personnel Distribution Office to provide requisite military personnel distribution and Naval Reserve recall.
  b. It is the basic document for current and future peacetime and mobilization Navy military manpower planning in the areas of personnel strength planning, recruiting, training, promotion, personnel distribution, and Naval Reserve, recall.
  c. It is the single official statement of organizational manning and Billets Authorized. Billets Authorized are the billets approved by CNO for current operating conditions and may, depending on the mission of the activity, represent full organizational manning, i.e., Ship Manpower Document (SMD) or Squadron Manpower Document (SQMD).

- ***Table of Organization (TO)***

  A Table of Organization (TO) describes the organizational structure and manpower requirements of units in terms of grade, Marine Occupational Specialty (MOS) civilian occupational series, weapon, and billet title for military and civilian personnel. It is the basic document that describes the composition of every Marine Corps organization in billet line detail.

- ***Navy VAMOSC Personnel Universe***

  The Personnel Universe is a data source to determine the number of persons assigned to a unit. This value can be compared to the authorized manpower in the Activity Manning Document as a measure of the percent manning in a unit.

<u>Navy Training Plan (NTP)</u>

NTP functions as the principle document for defining the following considerations: manpower, personnel, and training requirements for new aviation equipment, system, subsystem or total ship developments; ships transferred to the Naval Reserve; Reserve Programs; area training requirements or mission continuation; and the resources (manpower, training, equipment, military construction, etc.) necessary to support the training requirements.

The PMA-205 provided NTP controls the planning and implementing action for meeting the requirements for the system, subsystem, or subsystem component or non-hardware oriented development, to produce trained and qualified personnel required to install, operate, maintain, or otherwise use the same being introduced into the Navy.

Composite Standard Military Rates

The following paragraphs summarize the basic elements that comprise the Composite Standard Military Rates (CSMR). The source for this data is NAVCOMPT Manual, Section X, Sub-section 035750, Paragraph 3.

- **Basic Pay:** Represents a weighted average for longevity increments by pay grade as provided in President's budget justification.

- **Retirement:** Represents a percentage of basic pay to fund current costs of future military retirement. Amount credited to applicable military pay appropriation and then transferred to the DoD Military Retirement Trust Fund.

- **Basic Allowance for Quarters (BAQ):** Represents BAQ amounts by pay grade from the President's budget justification divided by total work-years in each pay grade from the DoD military personnel plan to yield an average cost per person in each pay grade.

- **Miscellaneous Expenses:** Represents an average cost, computed separately for officers and enlisted personnel, of amounts in the President's budget justification for the following expenses:

  - Basic Allowance for Subsistence (BAS)
  - Overseas Station Quarters
  - Family Separation Allowances
  - Separation Payments
  - Social Security Tax (FICA)
  - Death Gratuities
  - Servicemen's Group Life Insurance (SGLI)
  - Reenlistment/Enlistment Bonuses
  - Apprehension of Deserters

- **Permanent Change of Station (PCS) Expenses:** Represents an average cost, computed separately for officer and enlisted personnel, for PCS travel from the President's budget justification.

- **Incentive and Special Pay:** Represents an average cost, computed separately for officer and enlisted personnel, of amounts in the President's budget justification for the following:
  - <u>Aircrew (ACIP), Submarine, Diving Duty & Air Weapons Controller</u>. Rate for each pay grade based on current longevity by pay grade.
  - <u>Other Hazardous Duty</u>. Statutory amount authorized for specific types of hazardous duty.
  - <u>Physicians and Dentists</u>. Weighted average for each service based on current average longevity by pay grade.
  - <u>Optometrists and Veterinarians</u>: Statutory amounts for all officers.

- Engineering and Scientific Skills: Weighted average for each service based on current and projected experience.
- Nuclear Career Accession/Incentive Bonus: Rates proposed by SECNAV subject to limitations.
- Sea Duty and Duty at Certain Locations: Statutory amounts for each enlisted pay grade.
- Proficiency Pay: Rates authorized by DOD.
- Hostile Fire Pay: Statutory rate for all pay grades.

Federal Logistics Database (FEDLOG)

This source exists as an interactive query system using a variety of types of search data to significantly reduce the time required to access all information necessary to identify and order supplies. FEDLOG is available from the Defense Logistics Information Service at this website: https://www.webflis.dlis.dla.mil/WEBFLIS/default.asp

Support Equipment Resources Management Information System (SERMIS)

SERMIS is the replacement system for the Application Data for Material Readiness List. It is a collection of technical and cataloging data identifying support equipment end items required for "O", "I", and "D" level aircraft maintenance. Both CSE and PSE data are in SERMIS. SERMIS provides the Support Equipment Controlling Authority with on-line visibility of source, allowance, inventory, and rework data to aid in inventory control. Whereas AUTOSERD includes SERDs in development, SERMIS includes only approved SERD data. The two databases are independent. AUTOSERD and SERMIS data are useful for obtaining non-cost information; cost information can be obtained from procurement-history databases once the appropriate part numbers are identified from SERMIS. SERMIS is updated every two months. Access to SERMIS must be requested from NAWCAD-3.2.6, Lakehurst at 732-323-4102.

HAYSTACK

HAYSTACK provides on-line access to information on parts in the U.S. Federal Supply Catalog. It is designed to meet the needs of procurement and supply, logistics, engineering, contracting, sales and marketing, and material management. For further information, contact HAYSTACK at their website http://www.ihs.com/haystack/index.html.

NAVICP DEMAND

For any NIIN, this database will provide all demands from any customer that is a regular user of the ICP system. Demands from other services may be included in the numbers if they are also regular users. The demands for member NIINs (sub-elements) are rolled up under it's higher level NIIN. To get the specific demand for the higher level NIIN you will need to sum up the demand for all member NIIN's and subtract from the head NIIN's demand (to avoid double counting).

APPENDIX D: NAVY/MARINE CORPS COMPOSITE RATES

FY-05/ Rates
Composite Standard Rates

OFFICERS

Grade	Rank	US Navy	US Marines
O10	ADM/Gen.	$226,551	$206,047
O9	VADM/Lt. Gen.	$217,735	$205,311
O8	RADM-U/Maj. Gen.	$200,670	$189,093
O7	RADM-L/Brig. Gen.	$181,796	$182,964
O6	CAPT/Colonel	$175,827	$169,174
O5(H)	CDR/Lt. Col.	$151,966	$143,986
O4(I)	LCDR/Major	$137,459	$125,641
O3(J)	LT/Capt.	$111,461	$108,523
O2(K)	LTJG/1st Lt.	$87,497	$87,665
O1(L)	ENS/2nd Lt.	$71,796	$69,774

WARRANTS

Grade	Rank	US Navy	US Marines
CWO5	CHIEF WARRANT 5	$125,853	$129,495
CWO4(M)	CHIEF WARRANT 4	$125,642	$115,875
CWO3(N)	CHIEF WARRANT 3	$99,281	$101,788
CWO2(O)	CHIEF WARRANT 2	$98,621	$88,813
CWO1	CHIEF WARRANT 1		$77,383

ENLISTED RANKS

Grade	Rank	US Navy	US Marines
E9	Master Chief/MGySgt.	$111,106	$108,956
E8	Senior Chief/MSgt.	$94,699	$90,186
E7	Chief or GSgt.	$83,708	$78,259
E6	1st Class/SSgt.	$72,739	$67,058
E5	2nd Class/Sgt.	$61,760	$55,728
E4	3rd Class/Cpl.	$51,073	$46,593
E3	Air/Seaman or LCpl.	$43,777	$39,909
E2	Air/Seaman or Pfc.	$39,771	$35,513
E1	Air/Seaman or Pvt.	$36,013	$31,537

NOTE: The composite standard military pay rates represent the baseline, without any acceleration.
Per NAVCOMPT 035750 and Chapter 26 of DOD Accounting Manual 7220.9-M, acceleration factors are NOT used when billing DoD activities.
This data can be downloaded from: http://www.dod.mil/comptroller/rates/fy2005.html

APPENDIX E: COST ELEMENT METHODOLOGIES

Several of the methodologies contained herein reference the research of historical data pertaining to analogous systems. The analyst must exercise caution when selecting an analogous avionics system. Though a system has been designed to replace the function of an older system, the new avionics gear may use completely different technology than its predecessor. Consequently, the older avionics equipment will not prove to be a good reference for the costs associated with the avionics system under study. For example, a Digital Map System (DMS) designed to replace the AN/ASQ-196 may have graphics capability more technically compatible with the F/A-18 Heads-Up-Display (HUD) than the AN/ASQ-196.

ACQUISITION COSTS

Design

Methodology:

- Nonrecurring design costs are application specific and dependent upon the technical or process maturity of the concept under consideration. These costs should be included in the maintenance trade proposal.
- The cost analyst can verify the proposal's design costs by researching an analogous avionics system.

Production

Methodology:

- Production costs are application specific and dependent upon the technical or process maturity of the concept under study. These costs should be included in the maintenance trade proposal.
- The cost analyst can verify the proposal's production costs by researching an analogous system.

Installation

Methodology:

- Installation costs are application specific and dependent upon the technical or process maturity of the concept under study. These costs should be included in the maintenance trade proposal.
- The cost analyst can verify installation costs by researching modification/upgrade program costs for an analogous system.

ACQUISITION ILS COSTS

Logistics Support Analysis (LSA)/Maintenance Planning

Methodology:

- If a major system such as the AYK-14 is being replaced by another equally complex system, there will be acquisition costs.   A new maintenance plan will be required with the associated analyses, i.e. FMECA, FMEA, LORA.   LSA is no longer required, however, the contractor can elect to conduct the analysis.
- LSA cost estimation is well documented in the Cost Estimating for Logistics Support Analysis (CELSA) Guide but this will be of limited use with the cancellation of Mil-Std-1388.   Maintenance Plan development costs without LSA, will be based on the complexity of the system and its repair. If the system has no organic repair, the plan is not needed.   A simple Maintenance Plan will cost between $25K and $50K.   A complex plan may run up to $200K.

<u>Supply Support (Spares)</u>

Methodologies:

The Navy Inventory Control Point (NAVICP) at Philadelphia, formerly known as the Aviation Supply Office (ASO), has developed two approaches for forecasting retail spares demand. The Readiness Based Sparing (RBS) approach considers the readiness contributed to an entire aircraft (or total quantity of T/M/S aircraft at a site) by each unit of stock. RBS balances unit cost with operational availability to determine the optimum sparing levels of each unit required to achieve a prescribed aircraft readiness goal. The Chief of Naval Operations (CNO) specifies the readiness goal as the percentage of time a given aircraft should be fully mission-capable (FMC). These goals are generally in the 55% - 65% range.

For cost analyses at the systems level*, the Retail Inventory Model for Aviation (RIMAIR) provides an analyst with the best available tool for forecasting spares demand. Whereas RBS focuses on the sparing of multiple systems for achieving a single readiness goal, RIMAIR considers a fixed spares protection level for a system. <u>Spares protection level and readiness are not the same</u>. A spares protection level indicates how often a spare is available to replace a failed unit in the pipeline. Readiness, operational availability, and FMC describe how often an aircraft is able to perform its mission.

*In the case where sufficient failure and repair data (e.g., MTBF, repair TAT, IBCM rates) exists at a level lower than that of the system (WRA/SRA level), RIMAIR can be applied to each WRA/SRA individually.

- <u>Poisson Probability Distribution</u>

RBS uses a Poisson distribution to determine how many backorders would be avoided by increasing the number of spares for each unit of stock. Using this information, RBS calculates the readiness contributed to the entire aircraft by each unit of stock. The item that avoids the most backorders (i.e., provides the most availability) per dollar is chosen first. RBS then compares the contribution of stocking an additional unit of that item against stocking the first unit of a different item and continues the process until the readiness is met.

RIMAIR applies a Poisson distribution to each item to determine how many units must be stocked to achieve an approved level of protection against stock-out. If a spares protection level is not identified for the system under study, the cost analyst should adhere to the current NAVICP policy of 85% spares protection level. Using the 85% confidence interval, RIMAIR will determine the quantity of spares necessary to insure an 85% likelihood that a spare will be available upon demand.

The constant λ in the Poisson distribution represents the average total pipeline (average resupply pipeline + average repair pipeline) for the unit of stock. The average repair pipeline refers to the Intermediate level activity and the average resupply pipeline is based on the Shore Consolidated Allowance List (SHORCAL) and Aviation Consolidated Allowance List (AVCAL) requirements. Organizational level (O-Level) TATs are minimal and not considered in calculating spares since the function of the O-Level is simply to remove and replace items at the flight line. To simplify the calculation of λ, NAVICP uses a standard maintenance cycle of 100 hours. The λ equations presented herein use the MFHBF (or MTBF, if MFHBF is unknown) as a maintenance cycle providing a “demand based” approach to sparing. If MTBF is used in lieu of MFHBF, the analyst should use operating hours in the λ equations in place of flight hours. In accordance with NAVAIR-4.1.6, operating hours for an avionics system are derived by multiplying the flight hours by 1.25 to account for pre/post- flight test and inspection.

- <u>RIMAIR and RBS</u>

NAVICP uses the Aviation Readiness Requirements Oriented to WRAs (ARROWs) Model to estimate retail spares demand. ARROWs addresses the sparing of all systems within all aircraft at a particular site to achieve a prescribed aircraft readiness at the lowest possible cost to the Navy. Currently, NAVICP is conducting ARROWs on a site by site basis to consider the optimum sparing of aircraft at a site. There are four standard input parameters required for conducting the ARROWs model (resupply time at the shore and carrier sites (CV), peacetime flying hours and wartime flying hours). These input parameters are as follows: 15 day shore site resupply time, 20 day CV resupply time, peacetime flying hours for Navy land bases and Navy Reserve sites, and wartime flying hours for Marine land bases, CVs and LHs.

RBS is the recommended approach to estimating spares. However, the complexity of the level of effort and extensive site information associated with running ARROWs requires NAVICP to run this RBS Model.. Analysts addressing major systems or suites of equipment (i.e., avionics suite, radar system, or engine) are normally the only ones afforded the luxury of NAVICP support for running ARROWs to determine sparing levels. Consequently, NAVICP recommends using the RIMAIR approach for estimating spares at the system level when RBS cannot be performed due to time and/or resource constraints. The sparing levels RIMAIR provides are for estimating purposes only, budget and contractual sparing requirements will ultimately be determined by NAVICP using the RBS approach.

NAVICP is currently studying which standard inputs to RIMAIR provide spares estimates closest to the readiness requirements used in RBS. Until this analysis is complete, NAVICP recommends using 30 day SHORCAL for Navy land bases and all Navy Reserve sites, 90 day SHORCAL for Marine land bases, and 30 day AVCAL for CVs and LHs. These are the same input parameters NAVICP employs in their RIMAIR approach to determining interim support spares requirements.

- Calculating Retail Spares

RIMAIR calculates retail spares on a per site basis. The Poisson constant will vary according to the site under study. Aircraft quantity, flight hours (peacetime or combat) and allowance list requirements (AVCAL and SHORCAL) vary from site to site. Consequently, Poisson constants must be derived for each site. In the case where a shore site maintains CV aircraft in addition to land based platforms, the carrier aircraft are only used in the CV Poisson constant calculation. For example, the F/A-18E/F WSPD may identify 40 aircraft assigned to Naval Air Station (NAS) Oceana. However, the WSPD also shows 30 of those aircraft being deployed on a carrier(s) while at Oceana. The Poisson constant for Oceana will be calculated using 10 aircraft at peacetime flying hours. The Poisson constant for CV(s) will be calculated using a total of 30 aircraft using combat flying hours.

The number of carrier deployments identified in the WSPD for a specific year will not equate to the total of 11 CVs that are available for deployment. However, eventually each of the 11 CVs will be deployed at varying times in the future. Therefore, the cost analyst must calculate retail spares for 11 CVs. The maximum number of Marine LHs to use in RIMAIR calculations is 10.

Once the Poisson constants (identified as λ in the equations presented herein) have been calculated for each site, the RIMAIR spares equation is employed for each value of λ to determine the retail spares quantities.

Summary Table of RIMAIR Inputs

Standard Inputs	Study Specific Inputs
SHORCAL	MFHBF (or MTBF)
AVCAL	Aircraft Quantity at each Site
Peacetime Flying Hours	I-Level BCM Rate
Combat Flying Hours	I-Level TAT
Spares Protection Level	D-Level TAT

- Calculating Wholesale Spares

Wholesale spares are in place to ensure users receive a working unit from the supply system in exchange for submitting an item to the depot for repair. Unlike retail spares, the calculation of wholesale spares requires measuring spares demand across the entire user community, not individual sites. This spares demand is based on the number of depot repair actions. Wholesale spares are then calculated so they cover the system’s (or WRA/SRA if calculating at that level) attrition rate and standard depot repair

TAT. NAVICP adds an additional quantity of spares to the wholesale spares demand to serve as a safety level. The quantity of wholesale spares required to support the Fleet should be determined using the peak number of quarterly flight hours a system will endure during its life cycle.

Retail Spares Poisson Constant Calculation

Calculate the Poisson distribution constant using whichever of the following equations applies (λt is the average number of spares over a period of time):

For Navy land bases:

$$\text{NLB } \lambda t = (\text{MRF} \times \text{PFHM} \times \text{AQ} \times \text{SHORCAL}) + (\text{RPF} \times \text{PFHM} \times \text{AQ} \times (\text{ITAT} \div 30))$$

For Marine land bases:

$$\text{MLB } \lambda t = (\text{MRF} \times \text{CFHM} \times \text{AQ} \times \text{SHORCAL}) + (\text{RPF} \times \text{CFHM} \times \text{AQ} \times (\text{ITAT} \div 30))$$

For CV and LH deployments:

$$\text{CV } \lambda t = (\text{MRF} \times \text{CFHM} \times \text{AQ} \times \text{AVCAL}) + (\text{RPF} \times \text{CFHM} \times \text{AQ} \times (\text{ITAT} \div 30))$$

Where: MRF: Maintenance Replacement Factor = IBCM Rate ÷ MFHBF
IBCM Rate = BCM count ÷ Number of Items Processed
The MRF is the number of units found beyond capability of maintenance (BCM) at the I-Level activity (IBCM Rate) × per maintenance cycle (one cycle is equal to the average time duration between unit failures, i.e., MFHBF) per unit installed and for which resupply is required.

MFHBF: MFHBF = Total Flight Hours ÷ Total Failures
The maintenance cycle for these spares calculations is equivalent to the MFHBF (or MTBF) for the unit of stock.

PFHM: Peacetime Flight Hours per Month

CFHM : Combat Flight Hours per Month

AQ: Aircraft Quantity at the site

SHORCAL: Shore Consolidated Allowance List = 1 month for Navy land bases
3 months for Marine land bases

AVCAL: Aviation Consolidated Allowance List = 3 months

RPF: Rotatable Pool Factor = (1 - IBCM Rate) ÷ MFHBF
The RPF is the Intermediate level repair rate per maintenance cycle (one cycle is equal to the average time duration between unit failures, i.e., MFHBF) per unit installed.

ITAT: Repair turn-around-time (TAT) in days at the I-Level.

*If the BCM rate is unknown, use the VAMOSC data of an analogous system and compute the ratio of items BCM'd to the total number of failures. Verify with the system APML that this ratio (i.e., IBCM rate) will remain the same on the new system under study.

Retail Spares Calculation

Calculate the quantity of spares required at each site using the following equation:

CUMPDIST = 0	Set the cumulative Poisson protection level to 0.
For N = 0 to 1000	N represents the number of spares being evaluated.
If N = 0 Then	The factorial of 0 spares is 1.
FACT = 1	
Else	Calculate the factorial of the number of spares under consideration.
FACT = 1	
For I =1 to N	
FACT = FACT × I	
Next I	
End If	
PDIST = $[e^{(-\lambda)} \times \lambda^{(N)}]$/FACT	Calculate the Poisson protection level for the number of spares under consideration. λ represents whichever of the three Poisson distribution factors (NLB λ, MLB λ, CV λ) is applicable.
CUMPDIST = CUMPDIST + PDIST	Increase the cumulative Poisson protection level with the latest quantity of spares under consideration.
If CUMPDIST >= PL Then	Compare the Poisson protection level for this quantity of spares against the spares protection level (PL) identified for the unit. The PL is normally .85.
RSPARES = N	If the Poisson protection level for the quantity of spares under
N = 1000	consideration is greater than or equal to the spares protection level then this is the quantity of spares required for this particular site.
End If	
Next N	

Wholesale Spares Calculation

Calculate the total monthly aircraft flight hours for the system (or WRA/SRA) using whichever of the following equations applies:

For Navy land based aircraft: NLBFHM = PFHM × AQ

For Marine land based aircraft: MLBFHM = CFHM × AQ

For CV and LH deployed aircraft: CVFHM = CFHM × AQ

TOTFHM = NLBFHM + MLBFHM + CVFHM

Where: PFHM: Peacetime Flight Hours per Month

CFHM: Combat Flight Hours per Month

AQ: Aircraft Quantity at the site

Note: In the case where the system is used on multiple platforms, the total operating hours per month (TOTFHM) calculations have to be performed on each aircraft individually, and then summed to determine a complete TOTFHM figure.

Calculate the quarterly wholesale spares demand required to support the Fleet using the following equation:

$$QD = MRF \times TOTFHM \times 3$$

Where: QD: Quarterly wholesale spares Demand.

MRF: Maintenance Replacement Factor is the = IBCM Rate ÷ MFHBF
The MRF is the number of units found beyond capability of maintenance (BCM) at the Intermediate level activity (IBCM Rate) × per maintenance cycle (one cycle is equal to the average time duration between unit failures, i.e., MFHBF) per unit installed and for which resupply is required.

MFHBF: The maintenance cycle for these spares calculations is equivalent to the Mean Flight Hours Between Failure (MFHBF) for the unit (system, WRA, SRA) under study.

*If the BCM rate is unknown, use the VAMOSC data of an analogous system and compute the ratio of items BCM'd to the total number of failures. Verify with the system APML that this ratio (i.e., IBCM rate) will remain the same on the new system under study.

Calculate the additional wholesale spares required to cover attrition using the following equation:

$$ATS = QD \times PL \times WR$$

Where: ATS: Attrition Spares.

PL: Production Lead time in number of quarters. The average PL is 24 months or 8 quarters.

WR: Wear-Out Rate.

Calculate the wholesale spares required to cover depot repair TAT using the following equation:

$$DS = QD \times DTAT$$

Where: DTAT: Depot Repair Turn Around Time measured in quarters. The average DTAT is 2 months or .67 of a quarter.

Calculate the total wholesale spares quantity required to support the Fleet using the following equation:

$$WS = ATS + DS + SS$$

Where: WS: Total number of Wholesale Spares required to support the Fleet.

SS: Quantity of wholesale spares required to meet a safety level. The maximum number of safety level spares is equivalent to the quarterly demand. For estimating purposes the analyst may use the quarterly demand to meet the safety level sparing requirements.

Support Equipment (SE)

Methodologies:

- Acquisition Cost

In using an analogous system supported by PSE, an analyst has several methods available to determine the new PSE acquisition costs. One methodology requires the cost analyst to research the SERMIS database to identify the PSE by T/M/S aircraft used to support a system analogous to the system under study. Use the PSE NIIN obtained from SERMIS to capture the equipment's procurement history in the NAVICP MIF database. Adjust the PSE acquisition cost to the base year of the study using the latest NCCA Inflation Indices for APN. Multiply the PSE acquisition cost by the number of I-Level and D-Level (organic only) sites to obtain the acquisition cost for the new PSE. If the estimation is taking place during the conceptual milestone, perhaps two or three analogous systems should be used. If the BIT capability of the new system is known, it should be considered when choosing an analogous system.

The second method also requires the historical acquisition cost for the PSE, as well as the acquisition cost for the system being supported. The analyst creates a ratio of PSE-to-system acquisition cost. This ratio is then multiplied by the cost of the system under study to estimate its PSE cost. This method is not preferred because BIT capabilities are improving, and while such cost relationships may have had some historical validity, these patterns are most likely changing. Again, particularly if BIT capability is known, the first method is preferred.

- Development Cost

Among methods used for estimating PSE development costs is the "NADEP JAX Rough-Order-Of-Magnitude (ROM) Cost Model," originally applied to estimate CASS OTPS costs. It is sometimes referred to as the "Jacksonville Model." For PSE not included in the OTPS category, the analogous system approach may be used to estimate PSE development costs.

The Jacksonville Model provides the analyst with an accepted approach to estimating Rough-Order-of-Magnitude (ROM) development costs, without the need to perform any engineering analysis on the Units Under Test (UUTs), or have in-depth familiarity with the electronic components. However, the model is "Competition Sensitive," and use by contractors is forbidden.

The following is list of the input data required to run the model:

Summary Table of Jacksonville Cost Model Inputs

Number of WRAs
Number of SRAs
Number of Interface Devices (IDs)
Number of Production Sites
Development Time (months)
Production Time (months)
Contractor Recurring and Labor Rates*
Contractor Nonrecurring Labor Rates*
Government Labor Rates*

*If labor rates are not available to the analyst, the Jacksonville Model provides default values.

A copy of the “NADEP JAX Rough-Order-Of-Magnitude (ROM) Cost Model” can be obtained by U.S. Government agencies from:

Commanding Officer
Naval Aviation Depot
U.S. Naval Air Station
Jacksonville, FL 32212-0016
(Attn: Code 360)

A second, and nonproprietary, method is to identify and inflate the development costs of an analogous system. Use the latest NCCA Inflation Indices for RDT&E (Purchases).

Support Equipment Spares

The analyst can determine PSE spares using the same equations presented for system (WRA/SRA) spares in the “Spares” Section of this maintenance trade guidebook. The λ(s) for PSE is calculated using the inputs and equation provided below:

Summary Table of PSE Spares Inputs

Standard Inputs	**Study Specific Inputs**
SHORCAL	PSE MFHBF (or MTBF)
AVCAL	PSE Quantity per Site[1]
PSE Operating Hours	PSE I-Level BCM Rate
	PSE I-Level TAT
	PSE D-Level TAT

λt = (MRF × OHM × AVCAL (or SHORCAL, whichever applies)) + (RPF × OHM × (ITAT ÷ 30))

Where: MRF: Maintenance Replacement Factor is the = IBCM Rate ÷ MFHBF
The MRF is the number of units found beyond capability of maintenance (BCM) at the I-Level (IBCM Rate) per maintenance cycle (one cycle is equal to the average time duration between unit failures, i.e., MTBF) per PSE unit and for which resupply is required.

IBCM Rate: Percentage of failures that are found beyond capability of maintenance (BCM) at the I-Level activity.

MTBF: The maintenance cycle for these spares calculations is equivalent to the MTBF for the unit of stock.

OHM: PSE Operating Hours per Month[2]

SHORCAL: Shore Consolidated Allowance List = 1 month for Navy land bases
3 months for Marine land bases

AVCAL: Aviation Consolidated Allowance List = 3 months

RPF: Rotatable Pool Factor = 1 - IBCM Rate
The RPF is the I-Level repair rate per maintenance cycle (one cycle is equal to the average time duration between unit failures, i.e., MFHBF) per unit installed.

ITAT: Repair turn-around-time (TAT) at the I-Level activity[3]

1 – "PSE Quantity per Site" can be determined from SERMIS.
2 – "PSE Operating Hours per Month" is not tracked. Some PSE may have odometers, but not most.
3 – "ITAT" can be derived from 3-M data.

Note: if a PSE has an SM&R code of "I" (repair at I-level), then the IBCM rate reflects the attrition rate, since no depot repair is authorized.

Another way to estimate spares is to review the Spares Material List (SML). The majority of all PSE come with "bags" of spares when first installed at the O- and I-level sites. There is an "O-level bag" and an "I-level bag" of PSE subcomponent spares, which are drawn up by logisticians. The contents of the SML can be found on AUTOSERD and SERMIS, and also on the contract with the PSE manufacturer. The program office is a source for likely contents in the bags where contents have not yet been finalized. For estimating the contents for a modification to the bag, AUTOSERD can identify the existing contents, which can be reviewed with the program office to estimate the likely extent of changes.

Technical Data

Methodology:

- Paper: [(Total Pages O- Level) × (% Modified per Year O-Level) + (Total Pages I/D Levels) × (% Modified per Year I/D Levels)] × Average Actual $ per Page

- Class I,II,III,IV: [(Total Pages O- Level) × (% Modified per Year O-Level) + (Total Pages I/D Levels) × (% Modified per Year I/D Levels)] × Average Actual $ per Page

Software Modifications

Methodology:

- Please refer to the Software Maintenance sections of the guidebook.

Computer Resources

Methodology:

- Estimate the costs of any other computer related costs that are not accounted for in other ILS cost elements.

Training

Methodology:

- Coursework: (Hrs per Course to be Developed) × CDF × ($ Training Labor per MH)

Where: Hrs per Course: The number of training hours in a course should be identified in the maintenance trade proposal or the PMA-205 supplied Navy Training Plan (NTP) for the system under study. If not identified, the analyst can refer to an analogous system to derive an estimate of hours.

CDF: The course development factor (CDF) is equivalent to the number of man hours (MH) required to develop one hour of course work. If the CDF is not identified in the maintenance trade proposal, it can be supplied by the Naval Maintenance Training Group (NAMTRAGRU) or can be derived from an analogous system.

$ per MH: Contractor's cost per man hour (MH)

- Equipment: The cost for developing a training course can be determined using analogous information and added to the coursework calculation to derive a total training element cost.

Facilities

Methodology:

(Qty Square Feet Required) × (Cost per Square Foot)

Where: Qty Square Feet Required: The quantity of square feet required to support a system can be determined from an analogous system.

Cost per Square Foot: The cost per square foot for a typical Government facility.

PHS&T

Methodology:

(# of New Containers) × ($ per Container)

Where: # of New Containers: (# of Additional Retail Spares) + (# of Additional Wholesale Spares) + (# of Additional Attrition Spares)

O&S COSTS

"O" Level Personnel
Methodology:

(# of Removals per Year) × (O-Level Labor Rate per Hour) × (O-Level MH per Removal)

Where # of Removals per Year = (Total Flight Hours) ÷ (MFHBR)

"I" Level Personnel
Methodology:

(# of Removals per Year) × (I-Level Labor Rate per Hour) × (AVG I-Level MH per Removal)

Where # of Removals per Year = (Total Flight Hours) ÷ (MFHBR)

"I" Level Material
Methodology:

(# of Failures per Year) × (1-BCM) × (AVG I-Level Material Cost per Repair)

Where # of Failures per Year = (Total Flight Hours) ÷ (MFHBF)

NOTE: Support equipment and training devices have a different type equipment code (TEC) than an avionics system. As such, these ancillary pieces of equipment generally have their own WUCs. However, there may be occasions when maintenance personnel inadvertently enter charges against the WUC for the avionics system the associated equipment supports, rather than the WUC of the equipment itself.

D-Level Maintenance Support, Organic AVDLR
If the BCM rate is unknown, use the VAMOSC data of an analogous system and compute the ratio of items BCM'd to the total number of failures. Verify with the system APML that this ratio (i.e., IBCM rate) will remain the same on the new system under study. Multiply this IBCM rate by the projected annual failures (annual total aircraft flight hours divided by MFHBF) to determine the number of depot level repairables.

Multiply the number of depot level repairables by the AVDLR or contractor furnished depot level repair cost, whichever is applicable. For DVD analyses the primary source of demand rates will be the NAVICP demand database. If NAVICP has yet to establish an AVDLR cost for the system under study, identify an analogous system and retrieve the AVDLR associated with it. Determine a complexity factor based on the ratio of system under study acquisition cost to analogous system acquisition cost. Multiply the analogous system AVDLR by the complexity factor to determine the system under study AVDLR.

Methodology in Model: (# of Removals per Year) × (BCM % of Removals) × (AVDLR $ per Induction)

Where: # of Removals per Year Organic: (Total Flight Hours) ÷ (MFHBR Organic)

D-Level Maintenance Support, Commercial
Definition: There are six categories included in this classification.

1. **Maintenance Personnel**

Methodology:
(# of D-Level Inductions Cmml) × (D-Level Labor per Hour) × (D-Level MH ÷ Induction Cmml)

Where:
# of D-Level Inductions Cmml = (# of Removals per Year Cmml) × (BCM % of Removals Cmml)

# of Removals per Year = (Total Flight Hours) ÷ (MFHBR Cmml)

2. **Maintenance Materials**

Methodology:

(# of D-Level Inductions Commercial) × (Total D-Level Materials)

Where:
# of D-Level Inductions Commercial = (# of Removals per Year Commercial) × (BCM % of Removals Commercial)

# of Removals per Year: (Total Flight Hours) ÷ (MFHBR Commercial)

3. **NAVICP Cost Recovery Rate**
   Methodology:

   (% of Surcharge) × [(D-Level Materials) + (D-Level Personnel) + (D-Level Profit)]

   Where: D-Level Materials: As Calculated Above

   D-Level Personnel: As Calculated Above

   D-Level Profit: As Calculated Below

4. **Attrition Spares**
   Methodology:

   (# of Attrition Spares) × (Item Cost)

   Where: # of Attrition Spares: Develop the number of spares using the method described in the discussion of spares estimating.

5. **Recurring Transportation**
   Methodology:

(Shipping \$ per Pound Returned to Depot) × (# of D-Level Inductions Commercial) × (Item Weight)

Where: <u># of D-Level Inductions Commercial</u>: (# of Removals per Year Commercial) × (BCM % of Removals Commercial)

<u># of Removals per Year</u>: (Total Flight Hours) ÷ (MFHBR Commercial)

- WRA computation - If the BCM rate is unknown, use the VAMOSC data of an analogous system and compute the ratio of items BCM'd to the total number of failures. Verify with the system APML that this ratio (i.e., IBCM rate) will remain the same on the new system under study. Multiply this IBCM rate by the projected annual failures (annual total aircraft flight hours divided by MFHBF) to determine the number of depot level repairables. Compute the cost of shipping WRAs under organic support as follows:

  WRACost = Qty of WRAs BCM'd × WRA Weight × Cost per lb

- SRA computation - Compute the number of WRAs which were not BCM'd to a Designated Repair Point (DRP) using the VAMOSC data of an analogous system. Compute the failures per SRA by dividing the total number of failures for the WRA by the number of SRAs. Compute the number of SRAs requiring shipping by multiplying the average failures per SRA by the number of SRAs believed to be coded as repairable. If the weight and failure data are not readily available, the average SRA weight and the average number of SRA failures per year should be used to calculate shipping requirements.

  SRACost = Qty Repairable SRAs × Avg SRA Weight × Cost per lb × Qty SRA Failures

- The cost of shipping the SRAs and WRAs should be summed to calculate a total PHS&T cost estimate for organic support.

6. Profit

Methodology:

(D-Level Profit Percentage) × [(D-Level Material Cost) + (D-Level Personnel Cost)]

Where: <u>D-Level Materials</u>: As Calculated Above

<u>D-Level Personnel</u>: As Calculated Above

7. Recurring Facilities

Methodology:

Recurring facility costs are site dependent. Consequently, the analyst will need to identify the historical maintenance costs associated with maintaining similar space at the site in question.

Support Equipment Maintenance

Methodology

- Repair Cost

To determine the PSE I-Level material cost, obtain the I-Level material cost per aircraft flight hour for the system the PSE supports from the "I-Level Materials" Section of this guidebook. Inflate this cost-per-flight-hour to a cost-per-operating-hour by multiplying by the operating-hour-to-flight-hour ratio of 1.25 currently recommended by the AIR 4.1.6 Reliability & Maintainability (R&M) Division. Adjust this to the year of the study using the latest NCCA Inflation Indices for O&MN/LF (Composite). The result is the "current year weapon system material cost per weapon system operating hour" (when the aircraft is operating, it is presumed that all electronic systems are operating as well). Multiply this by the ratio of PSE acquisition cost to weapon system acquisition cost. The result is the "current year PSE material cost per (PSE) operating hour. Multiply this by the expected future PSE operating hours to determine the PSE's I-Level material cost per year.

Depot Level repair costs can be estimated as follows. Use the PSE NIIN obtained from SERMIS to capture its AVDLR cost in the NAVICP MIF database. Multiply this by the annual PSE operating hours. Multiply the result by the quantity of PSE sent to the depot per year. This depot quantity (or Maintenance Replacement Factor (MRF)) is the number of units found beyond capability of maintenance (BCM) at the I-Level activity (IBCM Rate) per maintenance cycle (one cycle is equal to the average time duration between unit failures, i.e., MTBF), which is simply: IBCM Rate÷MTBF.

Summary Table of PSE Repair Inputs

I-Level Material Cost for Avionics System
PSE Acquisition Cost
Acquisition Cost of the System the PSE Supports
PSE Operating Hours
PSE AVDLR
PSE IBCM Rate
PSE MTBF

As an alternative approach, the analyst could determine PSE annual maintenance cost by tracking any "Basic Ordering Agreement" (BOA) contracts that may have been awarded to support the PSE. PSE are often only needed and purchased in small quantities. Support systems for such small quantities would not be practical to put into place. Thus, a multi-year BOA contact might be awarded to place a repair company (the OEM or some other commercial shop) on retainer to repair any PSE units as they fail. Although PSE are originally bought by Lakehurst, with contracts awarded from NAVICP-Philadelphia, BOAs are not centrally located, and they would identify the repair company, but not the actual activity on the contract. The DoD contracting authority (DCAA) for the geographic region with the repair company should be able to identify any placed delivery orders, and how much money was spent for repair on the PSE. This entire process in not automated, but tracking activity associated with BOAs should result in identifying true PSE maintenance costs.

(Note - rough order of magnitude guidance for estimating: the V-22 prime contractor uses a 4% rate for PSE annual maintenance, that is, 4% of acquisition cost. An Air Force study on a different application, using the Air Force LCC-2 model, resulted in a 6% annual maintenance rate. A 5-7% rate of SE acquisition cost might be used as a rough general estimate, should a formal analysis not be feasible)

- SE Software (S/W) Maintenance

A ROM estimate for annual S/W maintenance costs for support equipment can be derived using the method provided in the Software Maintenance section of this guidebook.

Software Maintenance

Methodology:

- Software maintenance cost can be estimated using an analogous effort. Using the cost history of similar programs, a productivity measurement can be calculated, such as the number of full time staff persons per thousands of source lines of code maintained. This can be applied to the sizing estimate of the new program to approximate annual software maintenance cost. It is important to account for any differences in software language used between the analogous program and the program being estimated (see next two paragraphs).
- As an alternative, a commercial parametric cost model can be used. Software estimating tools generally use one of the following two methods.
    - The first is based on the quantity of changes to source lines of code (SLOC or LOC). This is useful when applied to languages traditionally used by military software developers, such as Assembly, FORTRAN, ADA, and ATLAS (nearly all TPS software is written in ATLAS). COCOMO, REVIC (REVised Intermediate Cocomo), and PRICE-S are examples of models which can be used in such instances. (REVIC includes military-specific data in its database as well as commercial data.) This type of model requires knowledge of attributes associated with the project, product, computer, personnel, etc. SLOC, source code language, labor rates, and complexity are some of the inputs. Machine-language-LOC-to-application-language-LOC ratios are used to properly scale the level of coding effort among the various languages. For example, ADA might have 10 machine-language LOC per ADA LOC; Assembly, being very close to machine language itself, might have a 2-to-1 ratio of machine-LOC-to-Assembly-LOC. Software productivity rates are created by the model, and after an Annual Change Traffic (ACT) percentage is calculated (which reflects the percentage of code requiring modification each year), a cost estimate is derived.

      Some models such as COCOMO/REVIC were originally designed for use by private sector software developers. Therefore, resultant cost estimates may need to be supplemented by additional government-incurred costs associated with initial system requirements design, software integration with the overall weapon system hardware, independent verification and validation, configuration management, and program administration. How many of these elements need to be considered depend on the level of modification to the software.

    - The second type of parametric software estimating model is based on the concept of "function points." The growing use and development of higher level languages and object-oriented programming concepts might render SLOC-based estimating approaches inappropriate. The "function points" methodology bases the estimate on evaluations of the work effort of individual program modules, such as input entry, outputs, database development, processing, etc. As such, a maintenance effort might only modify some of the processing functions; for example, only a visual output display. Some models, such as PRICE-S include the function points technique as well as the traditional software engineering approach (e.g., COCOMO). "SEER" is another function points model. The function points method may be the method of the future as blocks of code and library routines become activated by a single command or mouse-button click.

- Software cost estimates (acquisition or maintenance) are most commonly generated using a parametric model, supplementing the results with any applicable government costs not considered by the model, and conducting a "reality check." This "reality check" can be accomplished by comparing the results with those of an analogous system, or contacting the software engineers associated with the current or analogous software.

Note: Navy RFPs sometimes require submitters of proposals to include cost estimates using only the PRICE model.

- Another methodology that can be utilized to estimate software maintenance is to apply an Annual Change Traffic (ACT) percentage. For instance, a COCOMO value of 8% can be utilized to approximate the amount of code to be reworked on an annual basis. Knowing this, software productivity rates and labor rates can be applied to estimate the cost. Analogous program history is the preferred source for the ACT and rates.

- The following estimating relationships:
  - Simple: $MM(dev) = C \times 2.4 \times (SLOC^{1.05}) \times ACT \times \text{Labor Rate} \times \text{Total \# Years}$
  - Moderate: $MM(dev) = C \times 3.0 \times (SLOC^{1.12}) \times ACT \times \text{Labor Rate} \times \text{Total \# Years}$
  - Complex: $MM(dev) = C \times 3.6 \times (SLOC^{1.2}) \times ACT \times \text{Labor Rate} \times \text{Total \# Years}$

  Where: MM(dev): Original software development effort (man-months)
  C: Complexity Factor; 1 is default
  SLOC: Source Lines of Code
  ACT: Annual Change Traffic, 8% is recommended in COCOMO

The Computer Resource Life Cycle Cost Management Program (CRLCCMP) document contains government planning information on how the program is going to be managed with respect to software. These government planning data relate to operational requirements, quantity of modules in the program, contractors' historical charges per SLOC and program, etc., and may include information on cost differences between contractor versus in-house programming efforts. These documents should be available to a contractor supporting NAVAIR so long as the contractor is not also a software developer/competitor with an interest in obtaining proprietary data. The CRLCCMP documents are not on-line at this time. CRLCCMPs related to maritime surveillance aircraft (MSA) only are at the MSA library (301-342-2465), Patuxent River. The Patuxent River Central Library (301-342-1929) does not have the other CRLCCMPS. The program office may be the best source.

A second source of input data is the Cost Analysis Requirements Document (CARD). This describes software modules, functions, hardware, operating requirements, level of modification required, etc. The data are not available on-line, should be contractor-accessible, and should be available from the program office.

Both CRLCCMP and CARD are acquisition-required documents. These are living documents; they are continually updated, and record actual costs. They can therefore be used to acquire cost information on analogous systems. It is doubtful that CRLCCMP or CARD data are available for PSE software. The CRLCCMP is a large document that is expensive to develop and maintain (again, it is a living document). PSE software programs would not usually justify the creation of a CRLCCMP. The CARD data are created for the platform of the weapon system, so there are also probably no CARD data for PSE software.

Although the methods described above describe cost estimation of weapon system software, the same methods apply to PSE. For PSE TPS software, PRICE-S or COCOMO/REVIC are commonly used. Factors for parameters such as Enhancement, Maintenance, and Growth, are used to estimate maintenance costs of PSE software.

Recurring Training
Methodology:

- Training Preparation/Presentation Cost

(Hrs per Course per Year) × (PPF) × (Inst) × (Labor Rate) × (Total # of Years)

Where: Hrs per Course: The number of training hours in a course should be identified in the maintenance trade proposal or the PMA-205 supplied Navy Training Plan (NTP) for the avionics system under study. If not identified, the analyst can refer to an analogous avionics system to derive an estimate of hours.

PPF: The preparation/presentation factor (PPF) is equivalent to the time required to effectively present and teach the course. This PPF is 2 in most cases.

Inst: The number of instructors required to teach the course. This number should be supplied in the maintenance trade proposal or PMA-205 Navy Training Plan.

Contractor Training Labor $ per Year: Contractor's training cost per man hour (MH).

Program Support
Methodology:

(Labor Rate per Hour) × (Total # of Hours)

Other Support
Methodology:

(Labor Rate per Hour) × (Total # of Hours)

APPENDIX F: CURRENT AIRCRAFT INVENTORY PLANNING FACTORS

13000
Ser
N780G10A/4U789216
08 Jun 2004

From: Chief of Naval Operations

Subj: AIRCRAFT INVENTORY PLANNING FACTORS

Ref: (a) CNO ltr Ser N780G10A/2U634063 of 23 Jun 03
(B) OPNAVINST 5442.2G

Encl: (1) FY-04 Summary of Pipeline, Operational Loss Rate, Utilization Planning Factors

1. The planning factors contained in this letter are provided for service life planning for Type/Model/Series (TMS) aircraft in current operational use. Planning factors for newer aircraft will be included when sufficient actual data has been gathered to calculate a representative rate. The rates published in this letter supersede those forwarded by reference (a).

2. Enclosure (1) contains the following:

a. Category 1 strike projection percentages for Naval aircraft. Per reference (b), Category 1 strike is defined as loss or damage to the extent that restoration is uneconomical or militarily impractical. The rate is derived from an average of the past five years of actual data.

b. Pipeline projection percentages for Naval aircraft. These percentages are used to determine aircraft required over and above the primary authorized aircraft (PAA) to permit scheduled maintenance, modifications, inspections, and repair without reducing aircraft available for the operational mission. The rate is derived from an average of the past five years of actual data.

c. Utilization rates stated in hours/month for Naval aircraft. The rate is derived from an average of the past three years of actual utilization of aircraft in the entire active inventory and not just those in PAA.

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CLASS & TMS	CAT 1 STK FY99-FY03 AVG%	PIPELINE FY99-FY03 AVG%	UTILIZATION FY01-FY03 AVG (HR/MO)
FIGHTER/ATTACK			
FA-18A	0.9	17.0	21.1
FA-18B	0.8	13.8	16.3
FA-18C	0.6	11.6	29.6
FA-18D	1.3	11.1	30.2
FA-18E *	1.0	9.3	24.5
FA-18F *	1.0	10.4	28.4
NFA-18A	0.0	4.5	13.1
NFA-18C	0.0	2.9	11.8
NFA-18D	0.0	14.0	7.1
FIGHTER			
F-5E	0.8	19.5	24.3
F-5F	0.0	32.4	12.7
F-14A	3.6	11.9	25.3
F-14B	1.9	22.2	25.6
F-14D	1.2	25.2	23.7
NF-14A	0.0	3.5	10.6
NF-14B	0.0	5.9	10.2
NF-14D	0.0	17.0	10.2
ATTACK			
AV-8B	2.3	9.1	18.6
EA-6B	1.1	22.8	26.3
AIR ASW			
S-3B	1.6	16.9	35.4
WARNING			
E-2C	0.4	11.8	34.3
E-6B	0.0	13.5	86.9
EP-3E	0.0	31.2	60.1
TANKER			
KC-130F	0.8	18.3	34.3
KC-130R	1.8	16.5	41.1
KC-130T	0.0	13.2	32.7

CLASS & TMS	CAT 1 STK FY99-FY09 AVG%	PIPELINE FY99-FY03 AVG%	UTILIZATION FY01-FY03 AVG (HR/MO)
TRANSPORT			
C-130T	0.0	15.0	64.2
C-20D	0.0	23.5	49.5
C-20G	0.0	22.4	105.0
C-26D	0.0	9.2	32.4
C-2A	0.8	27.3	30.2
C-9B	0.0	31.8	87.2
DC-9	0.0	22.8	99.1
VP-3A	0.0	8.4	31.5
UTILITY			
RC-12F	0.0	5.9	40.5
RC-12M	0.0	17.7	53.1
UC-12B	0.0	8.6	64.8
UC-12F	0.0	2.9	41.3
UC-12M	0.0	4.7	55.6
UP-3A	0.0	24.2	25.5
TRAINER			
NT-34C	0.0	23.5	21.4
T-2C	0.2	4.5	25.9
T-34C	0.4	9.5	48.7
T-38A	2.3	10.4	11.6
T-39D	0.0	11.8	10.3
T-39G	0.0	15.0	53.9
T-39N **	3.1	21.7	62.8
T-44A	0.4	15.1	49.0
T-45A	0.6	13.0	42.0
T-45C	0.0	5.1	38.6
TAV-8B	1.6	15.1	16.7
TC-12B	0.0	8.3	59.8
TE-2C	0.0	2.9	41.9
PATROL			
P-3C	0.1	23.6	41.9
NP-3C	0.0	70.0	27.1
NP-3D	0.0	13.9	22.4

CLASS & TMS	CAT 1 STK FY99-FY03 AVG%	PIPELINE FY99-FY03 AVG%	UTILIZATION FY01-FY03 AVG (HR/MO)
HELO			
AH-1W	0.8	12.2	17.0
CH-46D	3.2	6.3	38.7
CH-46E	0.5	11.9	19.4
CH-53D	0.6	15.5	15.4
CH-53E	0.5	17.9	16.4
HH-1N	1.7	3.9	16.6
HH-46D	1.1	9.4	39.5
HH-60H	0.0	10.1	32.3
MH-53E	1.8	17.4	24.1
NSH-60B	0.0	13.2	8.0
OH-58C	1.0	0.0	11.1
SH-60B	0.6	15.9	41.6
SH-60F	0.0	14.4	34.2
TH-57B	0.5	3.5	43.2
TH-57C	0.6	3.1	50.2
TH-6B	0.0	5.9	14.8
UH-1N	1.7	12.9	18.3
UH-3H	1.9	16.8	24.3
UH-46D	2.1	3.7	39.0
UH-60L	0.0	25.8	22.9
VH-3A	0.0	0.0	15.7
VH-3D	0.0	26.7	27.1
VH-60N	0.0	27.2	27.7

* Limited 5 year data available for F/A-18E and F/A-18F. Initial attrition planning estimate set at 1.0 until sufficient actual data available. Actual 5 year rate for "E" = 0.0 and "F" = 1.4.

** 5 year attrition rate for T-39N unusually high due to limited number of aircraft in TMS

APPENDIX G: SHIPPING RATES

The standard government-arranged shipping rates were provided by NAVICP 0712.21 and can be found on the following page.

United Parcel Service (UPS) allows participants to access a "quick cost" estimating tool on their web site (http://www.ups.com). The user can choose virtually any point of origin or destination point, identify the mode of transportation, and specify any special or peculiar handling requirements. A "quick cost" estimate is then calculated.

Similar to the UPS web site, Federal Express provides users with an estimating tool. Their Internet address is http://www.fedex.com. Go to the "rate finder" and select the appropriate options.

OAST AVERAGE SHIPPING RATES
(FY 2002)

Type	Weight	Coast to Coast Conus (Truck)	Coast to Coast FedEx Small Package*	Norfolk To Sigonella (AMC Air)	Travis To Iwakuni (AMC Air)
NAVICP	1lb	MINIMUM $76.00	$5.51	$2.13	$2.74
Standard Government-Arranged	10 lbs	MINIMUM $76.00	$12.50	$21.30	$27.4037
* GSA Small Package Express	50 lbs	MINIMUM $76.00	$58.70	$106.50	$137.00
Contract with Federal Express	100 lbs	MINIMUM $76.00	$105.82	$213.00	$274.00
	150 lbs	$93.13	$164.32	$319.50	$411.00
Coast to Coast based on an average of 3000 miles	250 lbs	$155.22	N/A	$532.50	$685.00
	300 lbs	$186.27	N/A	$639.00	$822.00
	500 lbs	$248.35	N/A	$ 957.50	$1232.00

Type	Weight	Door to Door CONUS To Sigonella	Door to Door CONUS To Iwakuni	Door to Door Sigonella To CONUS (in Kilograms)	Door to Door Iwakuni To CONUS (in Kilograms
NAVICP	1lb	$10.75	$10.75	$44.12	$30.72
Commercial Air Express	10 lbs	$23.44	$23.44	$95.24	$60.91
	50 lbs	$79.42	$79.42	$298.61	$142.42
	100 lbs	$169.12	$169.12	$508.57	$363.55
	150 lbs	$253.63	$253.63	$709.36	$484.85
	250 lbs	$427.62	$427.62	$1102.21	$887.65
	300 lbs	$514.62	$514.62	$1302.99	$1093.73
	500 lbs	$862.62	$862.62	$2093.05	$1909.09

APPENDIX H: PAPER TECHNICAL DATA MODIFICATIONS

The following table was created as part of AIR 4.2.5's Electronic Technical Manual Cost Benefit Analysis study, published in September 1997. The sources of the data were thousands of Material Inspection and Receiving Reports (DD Form 250) maintained by NATSF. No other data source provides the number of changed pages and corresponding cost, the maintenance level of the affected technical manual, and the specific aircraft program. Specifically, the table displays the annual costs associated with changing, updating, and revising paper technical manuals for all the major naval aircraft programs for which significant data were available at NATSF.

> The columns of data in the table labeled as "Records" refer to the number of DD 250 forms that were examined. Averages were developed based on the fiscal years noted. The team collected all of the closed (i.e., completed) DD 250s available from NATSF. In some cases, the DD 250 did not provide the maintenance level of the affected manual. Those cases are recorded in the "Unknown Level" columns. Further, the team was usually not able to collect a full fiscal year of data for all of the years sampled. For example, when the team was collecting FY96 data for several of the aircraft programs, some of the DD 250s were still open.

For the F/A-18 program, NATSF directly administers only a portion of the technical manual changes. Boeing also receives an annual lump sum of contract resources from PMA 265 to support changes to F/A-18 technical manuals. The table contains only the NATSF administered portion of F/A-18 technical manual changes.

> Although the information collected for the P-3, S-3, H-1, and H-46 programs may appear sparse, all of these aircraft have been out of production for many years. Program Managers often do not possess the resources to keep their technical manuals up-to-date, and many technical manual budgets experience large fluctuations from year to year. These limitations are reflected in the information provided in the table.

HISTORICAL PAPER TECHNICAL DATA MODIFICATIONS IN FY 1996$

F-14 Year	O-Level Records	Pages	Price per Page	Total Price	I/D-Level Records	Pages	Price per Page	Total Price	Unknown Level Records	Pages	Price per Page	Total Price	Total Records	Pages	Price per Page	Total Price
FY92	0				1	10	846.04	8,460.37	0				1	10	846.04	8,460.37
FY93	112	6,080	585.25	3,558,315.49	14	138	692.76	95,600.47	0				126	6,218	587.64	3,653,915.96
FY94	337	30,121	587.60	17,699,053.11	135	2,268	659.56	1,495,877.23	0				472	32,389	592.64	19,194,930.34
FY95	480	14,779	723.21	10,688,358.57	175	3,359	747.53	2,510,949.29	0				655	18,138	727.72	13,199,307.85
FY96	260	23,692	435.00	10,305,989.60	18	3,191	541.25	1,727,144.20	0				278	26,883	447.61	12,033,133.80
Average (FY94&95)		22,450	632.24	14,193,705.84		2,814	712.07	2,003,413.26						25,264	641.13	16,197,119.10

F/A-18 Year	O-Level Records	Pages	Price per Page	Total Price	I/D-Level Records	Pages	Price per Page	Total Price	Unknown Level Records	Pages	Price per Page	Total Price	Total Records	Pages	Price per Page	Total Price
FY92																
FY93																
FY94	2	41	161.43	6,618.73	0				1	5	182.58	912.89	3	46	163.73	7,531.62
FY95	238	15,964	173.68	2,772,625.46	25	2,796	94.18	263,333.41	0				263	18,760	161.83	3,035,958.87
FY96	24	1,061	144.22	153,017.00	38	1,577	152.18	239,989.71	1	13	823.79	10,709.29	63	2,651	152.29	403,716.00

E-2 Year	O-Level Records	Pages	Price per Page	Total Price	I/D-Level Records	Pages	Price per Page	Total Price	Unknown Level Records	Pages	Price per Page	Total Price	Total Records	Pages	Price per Page	Total Price
FY92	41	752	524.49	394,416.49	2	87	786.69	68,442.40	0				43	839	551.68	462,858.89
FY93	82	5,182	899.57	4,661,559.78	19	2,751	806.92	2,219,832.69	0				101	7,933	867.44	6,881,392.46
FY94	50	4,055	777.40	3,152,336.76	19	2,390	1,110.03	2,652,971.52	0				69	6,445	900.75	5,805,308.28
FY95	38	4,414	457.54	2,019,578.03	35	4,670	1,136.30	5,306,517.11	0				73	9,084	806.48	7,326,095.13
FY96	38	1,989	974.09	1,937,472.36	94	9,020	576.76	5,202,387.08	0				132	11,009	648.55	7,139,859.44
Average (FY93,94&95)		4,550	720.35	3,277,824.86		3,270	1,037.54	3,393,107.10						7,821	852.99	6,670,931.96

EA-6B Year	O-Level Records	Pages	Price per Page	Total Price	I/D-Level Records	Pages	Price per Page	Total Price	Unknown Level Records	Pages	Price per Page	Total Price	Total Records	Pages	Price per Page	Total Price
FY92	8	72	676.32	48,694.97	72	1,480	678.71	1,004,497.30	0				80	1,552	678.60	1,053,192.27
FY93	87	13,661	238.10	3,252,656.36	98	6,569	569.46	3,740,776.77	0				185	20,230	345.70	6,993,433.13
FY94	97	3,253	499.59	1,625,166.66	41	1,613	654.34	1,055,454.07	0				138	4,866	550.89	2,680,620.73
FY95	21	820	721.22	591,396.37	39	1,498	603.64	904,252.85	0				60	2,318	645.23	1,495,649.21
FY96	69	3,704	794.29	2,942,062.00	13	289	744.89	215,274.00	0				82	3,993	790.72	3,157,336.00
Average (FY93,94&95)		5,911	308.40	1,823,073.13		3,227	588.89	1,900,161.23						9,138	407.45	3,723,234.36

P-3 Year	O-Level Records	Pages	Price per Page	Total Price	I/D-Level Records	Pages	Price per Page	Total Price	Unknown Level Records	Pages	Price per Page	Total Price	Total Records	Pages	Price per Page	Total Price
FY92																
FY93																
FY94																
FY95	47	833	23.72	19,761.19	8	399	31.46	12,552.25	0				55	1,232	26.23	32,313.44
FY96	68	3,276	23.49	76,966.05	11	555	15.99	8,871.97	2	70	29.91	2,093.78	81	3,901	22.54	87,931.80
FY97	12	2,468	14.70	36,268.95	0				2	161	33.16	5,338.84	14	2,629	15.83	41,607.79
Average (FY95&96)		2,055	23.61	48,363.62		477	23.72	10,712.11						2,567	24.38	60,122.62

HISTORICAL PAPER TECHNICAL DATA MODIFICATIONS IN FY 1996$ CONTINUED

S-3 Year	O-Level Records	Pages	Price per Page	Total Price	I/D-Level Records	Pages	Price per Page	Total Price	Unknown Level Records	Pages	Price per Page	Total Price	Total Records	Pages	Price per Page	Total Price
FY92																
FY93																
FY94																
FY95	16	273	17.89	4,884.30	6	556	18.02	10,020.93	0				22	829	17.98	14,905.23
FY96	9	76	17.67	1,342.92	3	62	17.67	1,095.54	0				12	138	17.67	2,438.46
Average (FY95&96)		175	17.78	3,113.61		309	17.85	5,558.24						484	17.82	8,671.85

H-53 Year	O-Level Records	Pages	Price per Page	Total Price	I/D-Level Records	Pages	Price per Page	Total Price	Unknown Level Records	Pages	Price per Page	Total Price	Total Records	Pages	Price per Page	Total Price
FY92	11	453	417.58	189,165.94	14	130	848.21	110,267.86	98	2,613	431.46	1,127,400.91	123	3,196	446.44	1,426,834.71
FY93	92	3,056	426.31	1,302,794.07	154	3,692	440.35	1,625,788.66	48	2,046	608.68	1,245,356.23	294	8,794	474.63	4,173,938.96
FY94	132	6,327	421.47	2,666,615.01	111	4,351	497.00	2,162,454.70	1	117	404.73	47,353.32	244	10,795	451.73	4,876,423.03
FY95	95	19,376	397.25	7,697,040.02	78	1,977	716.73	1,416,980.75	49	699	40.52	28,325.98	222	22,052	414.58	9,142,346.76
FY96	0				59	2,767	8.86	24,508.49	43	930	15.24	14,174.07	102	3,697	270.22	998,990.14
FY97	0				2	769	304.31	234,010.76	0				2	769	304.31	234,010.76
Average (FY93,94&95)		9,586	405.66	3,888,816.37		3,340	519.48	1,735,074.70		954	461.58	440,345.18		13,880	436.89	6,064,236.25

H-60 Year	O-Level Records	Pages	Price per Page	Total Price	I/D-Level Records	Pages	Price per Page	Total Price	Unknown Level Records	Pages	Price per Page	Total Price	Total Records	Pages	Price per Page	Total Price
FY92	4	117	402.87	47,136.32	183	6,846	419.61	2,872,669.86	0				187	6,963	419.33	2,919,806.18
FY93	267	10,561	415.85	4,391,773.89	284	8,667	449.40	3,894,935.56	0				551	19,228	430.97	8,286,709.45
FY94	326	16,292	454.33	7,401,942.59	104	3,884	649.73	2,523,542.60	0				430	20,176	491.95	9,925,485.20
FY95	530	18,756	427.77	8,023,330.94	142	5,470	513.60	2,809,365.77	27	1,920	430.84	827,222.28	699	26,146	445.95	11,659,918.98
FY96	33	1,985	543.70	1,079,242.32	36	1,524	706.87	1,077,276.75	0				69	3,509	614.57	2,156,519.07
Average (FY93,94&95)		15,203	434.50	6,605,682.47		6,007	512.06	3,075,947.98						21,850	455.71	9,957,371.21

H-1 Year	O-Level Records	Pages	Price per Page	Total Price	I/D-Level Records	Pages	Price per Page	Total Price	Unknown Level Records	Pages	Price per Page	Total Price	Total Records	Pages	Price per Page	Total Price
FY92																
FY93																
FY94	0				1	49	4.96	242.94	0				1	49	4.96	242.94
FY95	67	1,967	8.25	16,222.27	7	45	15.74	708.23	0				74	2,012	8.41	16,930.50
FY96	16	402	19.49	7,833.24	4	1,171	14.69	17,196.57	0				20	1,573	15.91	25,029.81
FY97	0				1	175	17.29	3,025.68	0				1	175	17.29	3,025.68
Average (FY95&96)		1,185	13.87	12,027.75		608	15.21	8,952.40						1,793	12.16	20,980.15

H-46 Year	O-Level Records	Pages	Price per Page	Total Price	I/D-Level Records	Pages	Price per Page	Total Price	Unknown Level Records	Pages	Price per Page	Total Price	Total Records	Pages	Price per Page	Total Price
FY92																
FY93																
FY94	0				1	9	18.37	165.29	17	817	7.30	5,967.98	18	826	7.43	6,133.27
FY95	3	19	27.35	519.58	2	24	18.02	432.56	157	16,935	15.73	266,331.09	162	16,978	15.74	267,283.23
FY96	0				2	150	25.78	3,867.00	0				2	150	25.78	3,867.00
Average (FY94&95)		19	27.35	519.58		61	20.72	1,488.28						5,985	16.32	92,427.83

APPENDIX I: PBL RECOMMENDED COST ELEMENT STRUCTURE

<u>Logistics Acquisition</u>

- LSA/Maintenance planning
- Supply Support (Spares)
- Support equipment
- Technical data
- Training
- Facilities (Avionics)
- Facilities (Engines, Aairframes)
- Packaging, Hhandling, Sstorage and Ttransportation

<u>Operations and Support Maintenance</u>

Maintenance

O-level repairs

- Burdened labor
  - Direct labor-maintenance manpower
  - Indirect labor-Overhead functions
  - Indirect materials
  - Other indirect (Recurring facility, equipment, training, etc.)
  - Base operating support
- Consumables

I-level repairs

- Burdened labor
  - Direct labor-maintenance manpower
  - Indirect labor-Overhead functions
  - Indirect materials
  - Other indirect (Recurring facility, equipment, training, etc.)
  - Base operating support
- Consumables

D-level repairs

- AVDLR
  - Direct labor-maintenance manpower
  - Indirect labor-Overhead functions
  - Direct materials
  - Indirect materials
  - Other indirect (Recurring facility, equipment, training, etc.)
- **Other sustaining support**
  - Support equipment
  - SW maintenance

Inventory management

- Direct labor
- Indirect labor
- Supplies
- Other indirect (Recurring facility, equipment, training, etc.)

Program support

- Engineering support
- Maintenance support